THE FOUNDRY

A Monthly Journal for all Departments of the Foundry Business

Vol. 40, No. 1 Cleveland, Ohio, January 1912 Whole No. 233

Continuous Operations in a Radiator Foundry

A Description of the Elaborate Labor-Saving Equipment in the Plant of the Kewanee Boiler Co., Kewanee, Ill.

IN ADDITION to its boiler plant, the Kewanee Boiler Co., Kewanee, Ill., operates an extensive department for the manufacture of cast iron radiators and in connection with this work has developed a continuous radiator foundry which contains a great many interesting features. The shop is designed on the straight line or multiple unit plan but differs from the average continuous foundry of this character in that the molding operations are practically automatic and are an integral part of the process.

The flasks proceed from one end of the shop to the other on small trucks running on narrow gage tracks. As they move forward, the various operations, such as covering the pattern with facing sand, filling the flask with molding sand, ramming, drying, core-setting, closing, pouring, cooling and shaking-out, are performed on each mold. All of these operations except those connected with setting the cores, pouring and shaking-out are entirely automatic and are performed by special parts of the mechanism. In addition, the core sand is removed from the finished castings

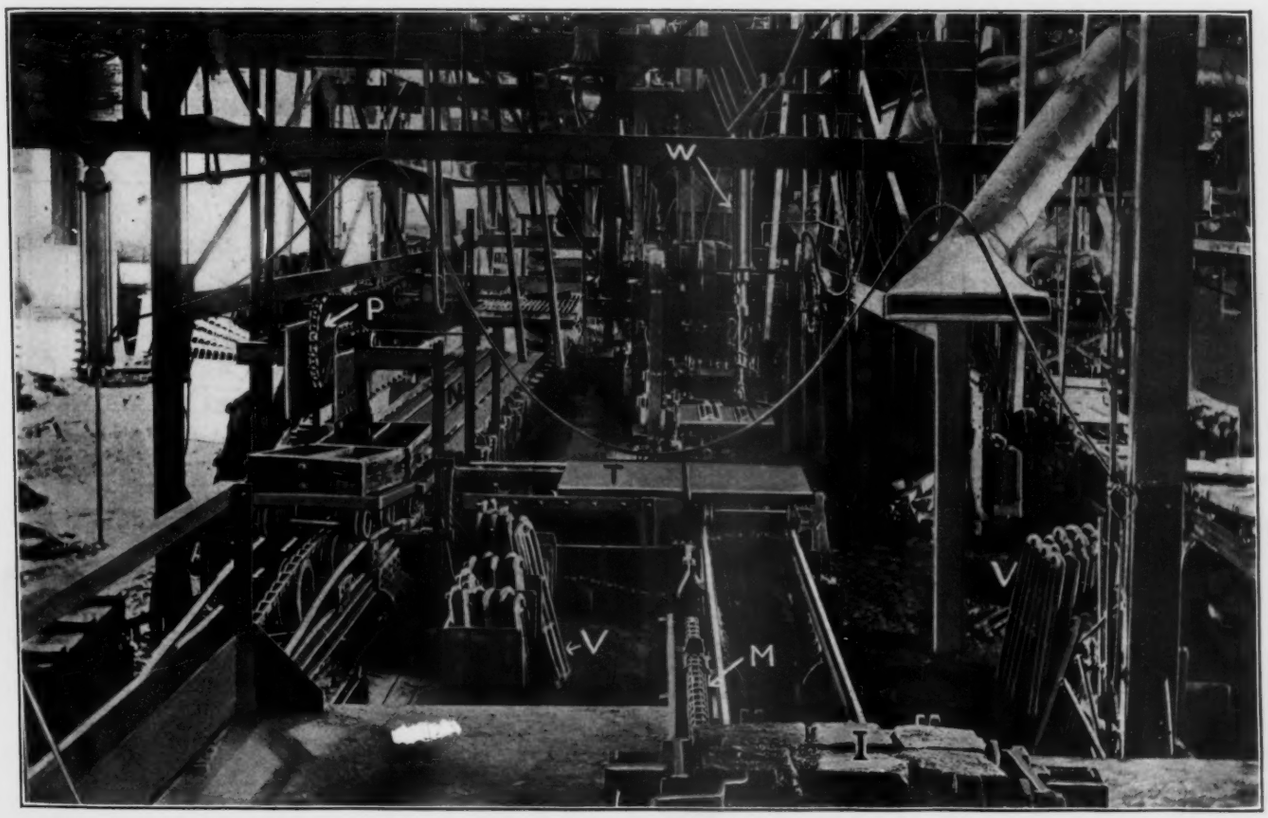


FIG. 1—VIEW OF A CONTINUOUS RADIATOR FOUNDRY, LOOKING TOWARD THE MOLDING MACHINE

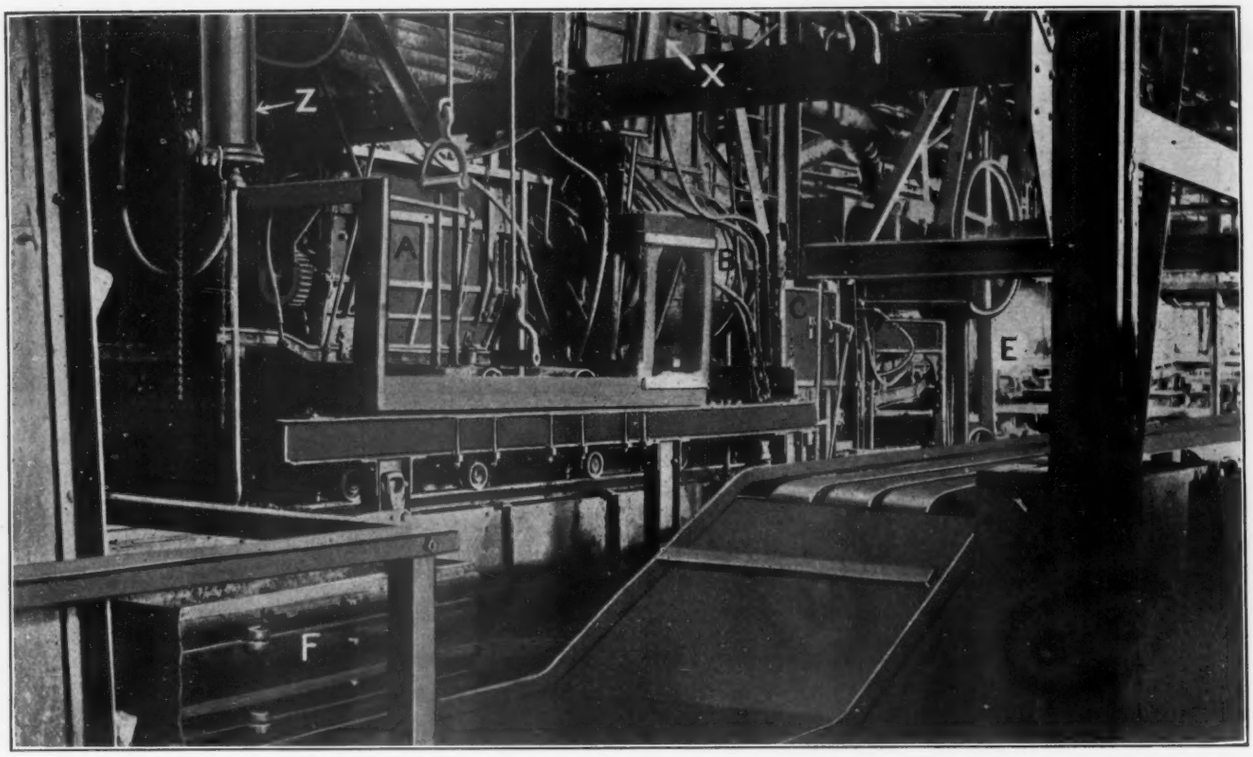


FIG. 2—GENERAL VIEW OF THE LARGE MOLDING MACHINE, SHOWING THE FACING AND MOLDING SAND BINS

and each piece is sand-blasted and cleaned by a continuous automatic process. There are also elaborate arrangements for preparing and handling the sand. It is thus seen that the plant is in reality one large machine composed of many individual parts, each of which performs a separate function.

A general layout of the mechanism is shown in Fig. 5. The process really commences in the core room, which is situated at the east end of the plant. This room is 60 x 160 feet, and the coremakers' benches are arranged along the walls. A wide gage track extends through the center of the room and in front of the ovens, which are at the east end. This track carries a transfer car by means of which the core trucks are distributed throughout the shop. The general arrangement of the transfer track, ovens and connections is shown in Fig. 5. The transfer track is also used to convey the finished cores to the main foundry. The core room practice is standard and presents no unusual features.

Five Main Units

The equipment in the foundry is divided into five main units which are laid out successively from east to west, as shown in Fig. 5. In their proper order these comprise the molding unit, the flask cooling and shak-

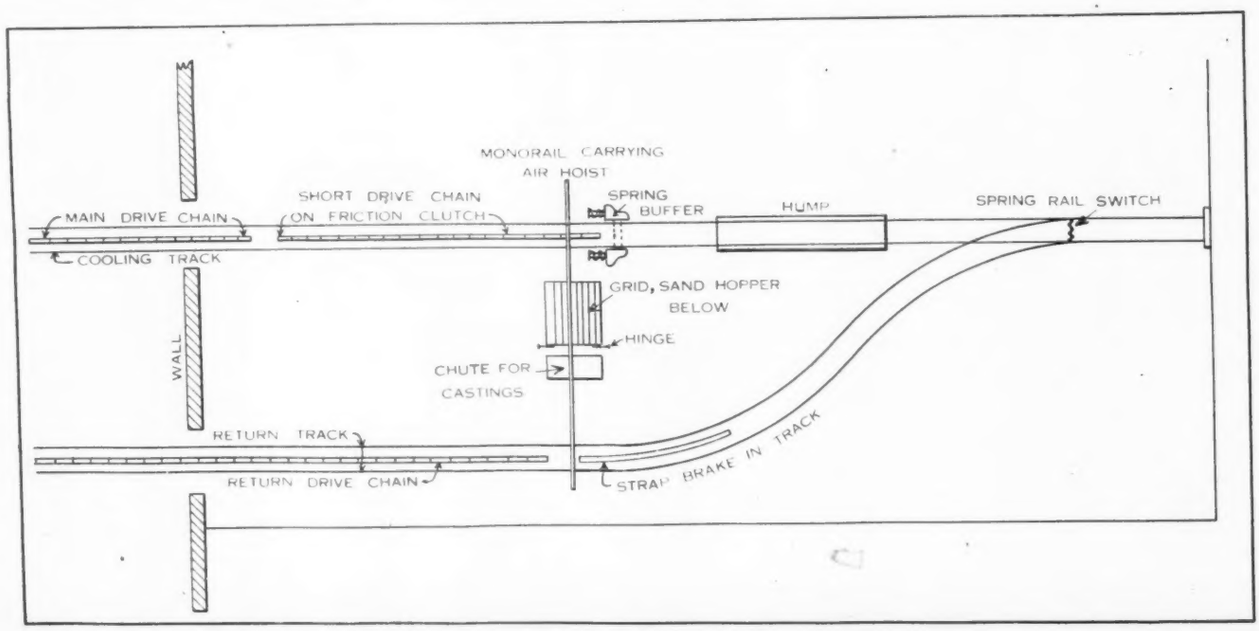


FIG. 3—SKETCH, SHOWING THE MAIN FEATURES OF THE SHAKING-OUT STATION

✓ 605 F63
U.40

FIG. 4—THE COOLING TRACK, LOOKING TOWARD THE SHAKING-OUT PLATFORM

ing-out unit, the core-removing and cooling unit, the sand blast unit and the finishing unit.

The molding unit consists of two molding and ramming machines, placed parallel to each other. One is double and the other is single. The single machine is the larger and its principal parts are indicated in Figs. 2 and 5. Two cooling tracks with a common return are used in connection with the double machine, while only one cooling track is necessary for the other. To give some idea of the capacity of the shop, it may be stated that the large single machine can easily produce 48 flasks an hour, each containing molds for two radiator columns. To operate it, 22 men are required.

The Molding Machine

The general features of both molding machines, with their connecting cooling and shaking-out apparatus, are the same, and on account of its comparative simplicity, only the large single machine will be described. It is situated, as indicated in Fig. 5, at the west end of the shop.

Since the radiator columns are symmetrical, the same half pattern serves for molding both the cope and the drag. Metal patterns are used and are mounted on follow boards in pairs, each pair being carried by one of the small trucks running on the molding track. The trucks bearing the patterns are brought up to the level of the molding track from the return tunnel by an hydraulic lift situated just behind the pile of flasks, *F*, Fig. 2. Two men are

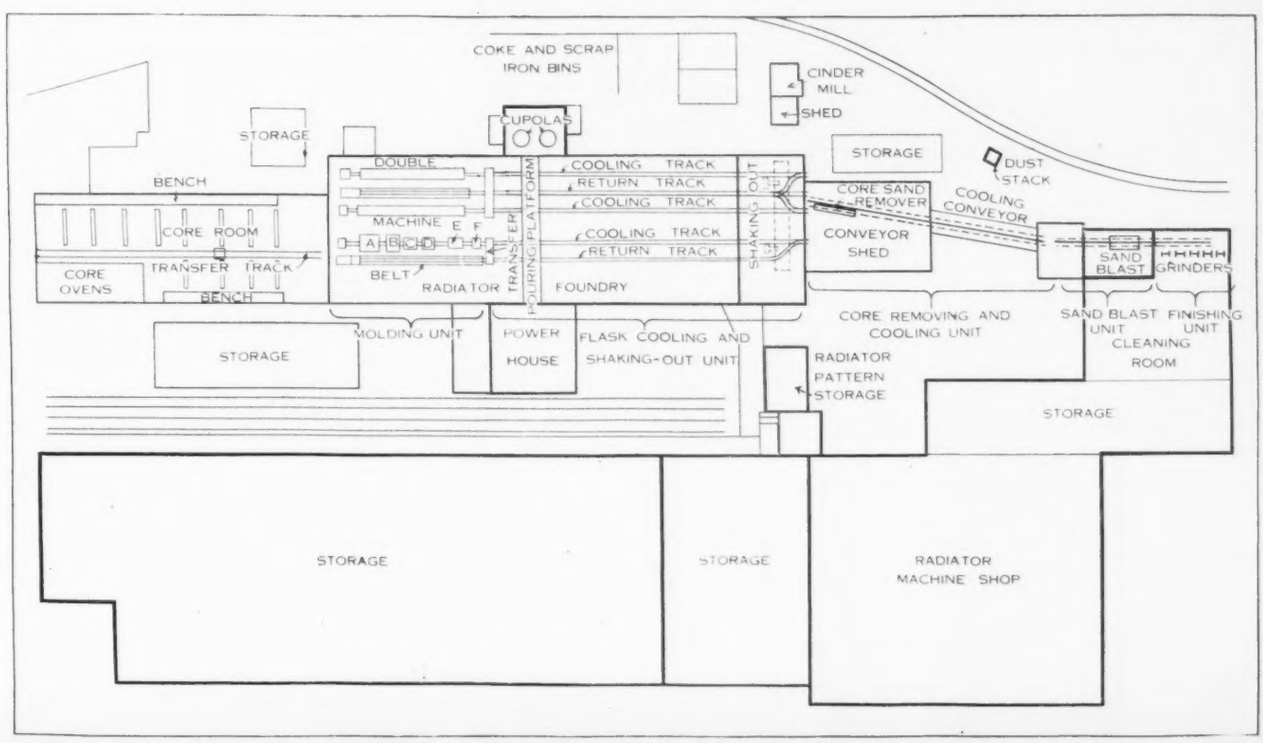


FIG. 5—PLAN VIEW OF A PORTION OF THE KEWANEE BOILER CO.'S PLANT, SHOWING THE LAYOUT OF THE CONTINUOUS RADIATOR FOUNDRY

stationed at this point and with the aid of the air hoist, *Z*, Fig. 2, they remove the flasks successively from the pile, *F*, and place them on the trucks as the latter are lifted out of the tunnel. The men clean the surface of the pattern with a blast of air and see that the flask fits snugly on the truck before they allow it to pass into the molding machine. The trucks, each one bearing one-half of a flask, move through the machine in a close column, being propelled by an endless chain which runs between the rails of the molding track. The movement of this chain is controlled by a man stationed at the delivery end where the flasks are removed from the patterns.

When first entering the machine the flask, which is 5 feet long and 4 feet wide, passes under the bin, *A*, Figs. 2 and 5, which contains facing sand. This bin is provided with gates at the bottom controlled by an air cylinder, the latter being operated by a trip placed in the track. When a truck bearing a flask reaches the proper point, the trip operates and the air cylinder opens the gate in the bin, discharging the proper quantity of facing sand onto the pattern. The mechanism is so adjusted that the air cylinder automatically closes the gate at the proper time. A mechanically-operated screen is placed directly under the bin so that the sand is properly riddled before it falls onto the pattern.

The flask next passes under bin *B*, Figs. 2 and 5, which contains ordinary molding sand. This bin has double undercut gates operated by the air cylinder, *X*, Fig. 2. The gates are opened at the proper time by a trip placed in the track, and the flask is filled with sand. It next passes under the rammer, *C*, which packs the sand closely around the edges on the pattern and flask. Leaving this point, the flask proceeds to the ramming machine, *D*, where the sand is thoroughly rammed over the whole area of the flask. Finally it passes over gas jets placed at *E*, which warm the pattern preparatory to removing it from the mold. At the extreme west end of this portion of the apparatus shown at *F*, Fig. 5, the flask is removed from the pattern by an air hoist, *W*, Fig. 1, rolled over while in the air and placed on the cooling truck, *T*. At this point the cores, *V*, Fig. 1, are set in the mold and the cope, which immediately follows the drag through the molding machine, is placed in its proper position. The trucks that are used to carry the flasks through the molding machine are returned to their initial point through a tunnel underneath the molding track.

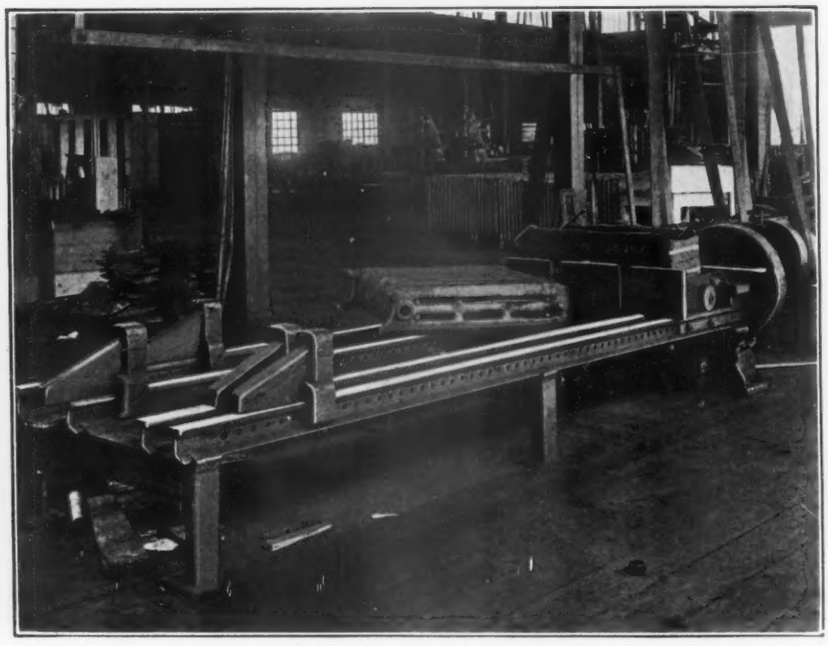


FIG. 6. RADIATOR ASSEMBLING MACHINE FOR FORCING COLUMNS TOGETHER

The general construction of the two sand bins is shown clearly in Fig. 2. The ramming machine, *C*, consists of a rectangular iron frame made a little smaller than a flask and carried on eccentrics which give it a vertical motion of about six inches. It is caused to operate at the proper point by a latch placed in the track.

The ramming machine, *D*, runs continuously, being belt-driven by an electric motor. It consists of a large number of individual rammers, each about two inches in diameter, operated by small cranks which give about 100 strokes per minute. The length of stroke is so adjusted that the sand is rammed to the proper density.

The iron is melted in two 48-inch cupolas situated on the south side of the shop, as shown in Fig. 5. Since the foundry operates continuously, the cupolas are used alternately, one one day and the other the next, thus giving ample opportunity for repairing the lining and keeping each stack in operating condition. They were designed and built by the Kewanee Boiler Co.

A steel platform extends from the cupolas across the shop over the tracks carrying the flask cars. The edge of this platform is seen in the immediate foreground in Fig. 1. After each flask is closed and started on its journey up the cooling track, it passes under this platform and is automatically stopped long enough for the molds to be poured. While being poured, the flasks are weighted down, as shown at *I*, Fig. 1. This portion of the cooling track is equipped with a short drive chain, *M*, by means of which the movement of each flask car as it passes under the pouring station can be controlled individually.

After the molds are poured they pass on to the cooling section of the apparatus, which is shown clearly in Fig. 4. This consists of a track 145 feet long, inclined so as to reach the second floor level at its outer extremity. The cars are carried slowly up the track by a chain. The empty flasks are returned on a parallel track shown at the extreme right; it terminates at the transfer table, *T*, Fig. 1, where the cars are carried across the space between the two tracks and started back on their journey with a new mold. The flasks, of course, must be returned to their initial point at the east end of the molding machine.

Belt Conveyor for Empty Flasks

To accomplish this an ingenious arrangement has been devised. As the cars with the empty flasks arrive at the transfer table, *T*, Fig. 1, the flasks are swept off onto the quadruple belt, *N*, by means of a drag attached to the short chain, *P*. The delivery end of the quadruple belt is shown at the right in Fig. 2. At this point the flasks slide down on a steel receiving platform, from which they are picked up and properly piled by the air hoist.

The shaking-out platform is situated just beyond the wall seen in the background in Fig. 4, and a detailed sketch

of the equipment at this point is shown in Fig. 3. Referring to this illustration, is will be noted that the cars bearing the molds drop the long drive chain which has carried them up the incline as soon as they arrive at the top, and immediately pick up a short chain which is driven through a friction clutch. At the proper point the cars are stopped by buffers supported on coil springs, the short drive chain also stopping. The movement of the long chain is controlled from the platform. As soon as the car is brought to rest, the cope and drag are lifted off by an air hoist and placed successively on the grid shown between the two tracks in Fig. 3. This grid is provided with quick operating clamps which hold the flask securely and is hinged on one side like a trap door. It is oscillated rapidly by an air-cylinder, which shakes all the sand out of the flask and is then rotated through nearly 90 degrees so that the castings fall down the chute placed at one side.

After the flask is removed from the car the buffer is released, which sets the short drive chain again in motion. This propels the car over a hump in the track just beyond the buffer. From the summit of the hump the car runs by gravity through the switch at the end of the track and drops back on the return track, being prevented from running away by a strap brake placed between the rails. It has just sufficient momentum to pass over the brake and is immediately taken up by the long drive chain in the return track. As it passes the sand grid on its way back, an empty flask is placed on the platform.

The sand falls through the grid into a bin, from the bottom of which it drops onto a short cross belt terminating in the boot of a bucket elevator. The latter hoists the sand to a hopper on the second floor level, from which it passes through a revolving riddle and mixing machine, finally dropping out on a long tempering belt that carries it back to the molding bins shown in Fig. 2. Before being finally dropped into the molding bins, it passes through supplementary tempering apparatus where the proper proportion of new sand is added.

Knocking Out the Cores

The finished castings, which may now be termed radiator columns, drop down a chute from the shaking-out platform and slide out on a table situated underneath. From this point they are carried to the sand-blasting machine by a slowly moving conveyor, 130 feet long. It consists of an endless chain provided with hooks at frequent intervals, on which the hot radiator columns are hung. The conveyor moves approximately 6 feet per minute, thus giving the columns ample time to cool before they arrive at the sand-blasting machine.

At the initial end of the cooling conveyor there are three steel rails so actuated by cams that they pound the radiator columns as they are carried along. The pounding action knocks the core sand out of the castings, so that when they reach the delivery end of the conveyor they are clean inside.

The location of the sand blast machine is shown in Fig. 5. The columns are carried through the machine by a chain conveyor which delivers them to the cleaning room, situated at the extreme west end of the plant. In passing through the sand blast machine, the exterior surface of each column is thoroughly cleaned and polished and all the molding sand is removed. The machine has four sand nozzles on each side and is provided with a device which separates the molding sand from that used for sand-blasting. This is accomplished by taking advantage of the different specific gravities of the two kinds of sand.

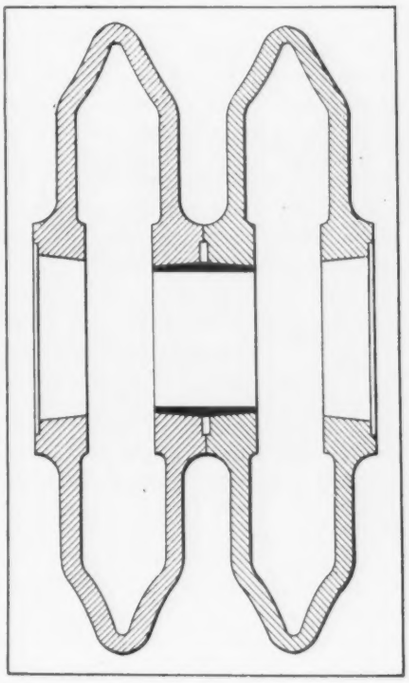


FIG. 7—SECTION THROUGH THE HUB OF A RADIATOR, SHOWING THE MALLEABLE IRON NIPPLE

The cleaning room is 80 feet square and is equipped with five emery grinders placed in a row in front of the conveyor leading from the sand blast. The castings receive their finishing touches on these wheels, which remove any fins or irregularities.

Leaving the cleaning room, the columns proceed through a storage room, 40 x 160 feet in size, to the radiator machine shop situated on the north side of the plant, as shown in Fig. 5. This shop is 130 x 160 feet and is equipped with the necessary tools for assembling and finishing radiators. The columns are not screwed together, but instead are joined by malleable iron nipples, as indicated in Fig. 7. This gives a perfect iron to iron force fit which does not leak and the malleable nipples are sufficiently heavy to lend the necessary strength to the structure. The columns are forced together in a machine, Fig. 6, especially designed for this purpose. It is provided with adjustable clamping blocks at the outer end and with a head block moved by screws. After the radiator has been loosely put together it is placed in the machine and squeezed up to a close fit.

East of the radiator machine shop is a large storage warehouse 419 feet long and 120 feet wide, provided with ample facilities for storing, packing and shipping the finished product.

The Production of Zinc

A series of artistic pamphlets treating of the elementary non-ferrous metals are being issued by the Lumen Bearing Co., Buffalo. One of the most recent describes the origin, characteristics and uses of zinc or spelter. The concentration of the ore, it is stated, is attended with some difficulty, as the associated impurities are about the same weight as the ore. The concentrates are either calcined or roasted, according to whether they are from carbonate or sulphide ore. They are then mixed with sufficient carbon to bring about reduction, and are heated to redness in retorts when the reduced zinc distills out and is collected in suitable condensers. Zinc is manufactured in the form of slabs, about one inch thick. It has a highly crystalline structure and at ordinary temperatures is quite brittle. Between 230 and 300 degrees Fahr., however, it is sufficiently malleable to be drawn into thin sheets and wire. The specific gravity of cast zinc is 7.142 and the melting point, 786 degrees Fahr. It boils at 1,800 degrees Fahr., and the vapor is readily condensed in the absence of inert gases. It is a poor conductor of both heat and electricity. The United States is the largest zinc producer of the world, the total output in 1910 having been 560,000,000 pounds.

The Scientific Operation of a Foundry

A Description of the Use of a Slide Rule for Fixing Piecework Prices of Molding in a Western Casting Plant

By Charles J Simeon

THE term, *Scientific Management*, applied to manufacturing, embraces such a wide range of methods, systems and appliances that a short, comprehensive definition is almost impossible. Perhaps the phrase, *Get posted beforehand*, covers as large a portion of the field as could be described by any sentence of equal length. That is to say, a large part of scientific management has to do with insuring that the factory has satisfactory answers, before it does a stroke of work, to the three following questions:

Exactly what has to be done?
What is the best way to do it?
How long should it take?

A pre-knowledge of the answer to each of the above questions is of paramount importance to successful manufacturing, but only the last will be considered in this article.

The labor cost is that portion of the total cost which is generally the largest and nearly always the most elusive and difficult to regulate. Accurate, prior knowledge of the time in which work should be done has a value that cannot be overestimated in reducing the labor cost under day work, and is an essential under a piecework, bonus, premium or kindred system. Thanks to Messrs. Taylor, Barth and others, the problem of ascertaining the proper times for machine work has been standardized and the solution reduced to mathematical form so that it is a comparatively simple matter to calculate the exact time in which a given piece of machine work should be done.

Methods of Setting Piecework Prices

But, so far as the writer knows, no similar attempt at a mathematical analysis of the foundry problem has been made. There are, of course, many methods employed for setting piecework prices or determining premium or bonus times for foundry work, the following being the ones generally followed:

(a) The personal judgment of the superintendent, foreman or other official.

(b) Comparison with records of previous performance.

(c) A tonnage of weight basis.

(d) Time study.

Each of these methods has its disadvantages, as follows:

(a) The personal judgment method, unless much time and care are taken, is little better than intelligent guesswork.

(b) Comparison with records requires that the same or a closely similar piece be made a number of times previously, and at best is a plunge in the dark as the conditions obtaining when the record was made, which have an important bearing, are seldom recorded, and quickly forgotten.

(c) A tonnage basis is approximately accurate when applied to small and similar work, but may be grossly misleading in other cases.

(d) The time study method is good, but too cumbersome and long for frequent and continuous use.

Premium Plan

All of the above methods may give good results under certain conditions, particularly when the work is repetitive and similar, but will seldom prove satisfactory where a line of castings, diverging considerably in weight, shape and intricacy, are made. Such conditions prevail in the foundry operated by the company by which the writer is employed. This concern builds several types of heavy machinery in a number of sizes and operates large steel and iron foundries in connection with its other shops. The castings required run in all weights from a few ounces up to 10 tons each and through a corresponding range of intricacy. A large proportion of the tonnage, moreover, consists of castings that are not made more than once or twice in a year. The premium plan of payment is in use throughout the factory and it is the writer's duty to supervise and approve all rates set, including those in the foundry.

Until about 18 months ago all premium rates in the foundry were set by one of the previously outlined methods. At that time, the predecessor of the writer conceived the idea of analyzing all the elementary operations performed in molding, expressing them in mathematical form. He carried out a series of time studies and produced a molding formula that gave good results, and the writer continued the work and modified the formula to one that could be used with a logarithemic slide rule.

Slide Rule for Setting Rates

As will appear later, the slide rule method of setting rates is, in reality, a modification of the time study method. For the slide rule is virtually a table, compiled from a large number of time studies, which gives the unit times required for performing the various elementary operations, and is a convenient method of combining these elements with the dimensions and intricacy of the casting to give the total time required by the whole. To understand how the formula was derived, let us consider an example.

A typical floor molding job may be split up into the following elementary operations:

1—Clear the floor, set the bottom board, the drag flask and the pattern.

2—Shovel facing sand and ram around the pattern.

3—Shovel bank sand and ram up the drag.

4—Clamp the bottom board and drag.

5—Obtain crane and roll-over the drag.

6—Remove the clamps and bottom board, sweep-off, place cope and sprinkle parting sand.

7—Set runners for heads and gate, shovel facing sand and ram around the pattern.

8—Set gaggers, shovel bank sand and ram up cope.

9—Obtain crane, lift off cope and remove pattern.

10—Finish mold, cut brackets, nail and coat with silica wash.

11—Finish heads and gates.

12—Set cores, chaplets and chills.

13—Obtain crane, pick up cope and test for correct core-setting.

14—Close-up and clamp ready for pouring.

The formula and slide rule, as ultimately developed, are based upon the theory, verified by actual time study and observation, that the times required for performing each of the elementary operations enumerated, are, within a degree of accuracy, close enough for practical purposes, functions of one or more of the dimensions of the flask,

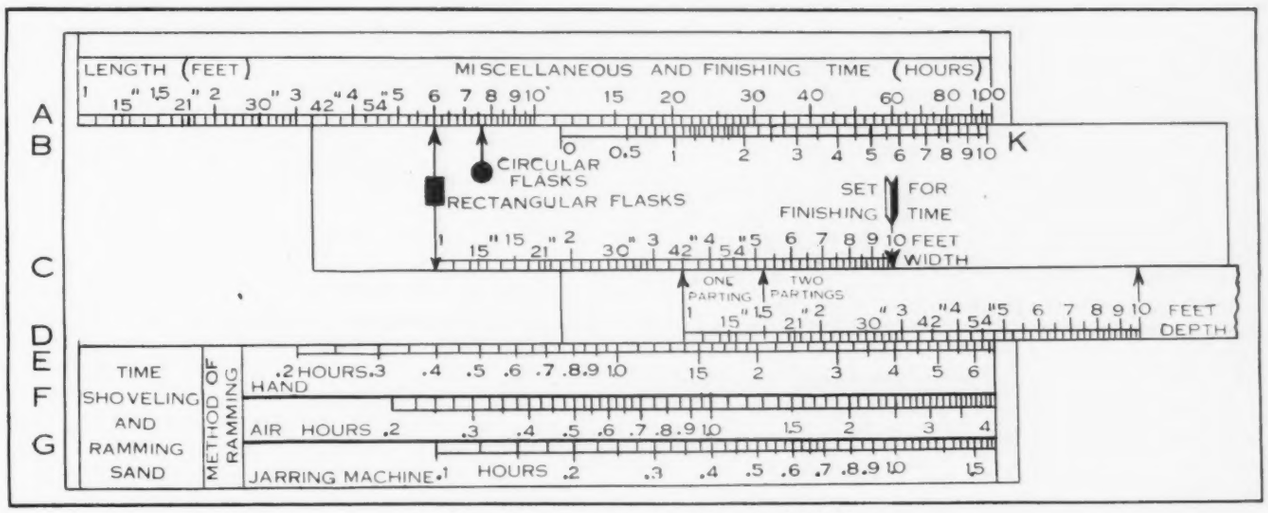


FIG. 1—SLIDE RULE IN FIRST POSITION

certain of these times being, in addition, functions of the intricacy of the pattern and the method of ramming employed. The formula derived was in this form:

$$T = \frac{VA}{a} + \frac{A}{b} + \frac{AK}{c} + \frac{Vr}{d}$$

Where T = the proper molding time.

A = Area of the flask in feet.

V = Volume of the flask in feet.

K = A variable known as the *Intricacy Factor* of the pattern.

r = A constant, known as the *Ramming Factor*, depending on the method of ramming, whether by hand, by air rammer, or by jarring machine; a, b, c and d are constants.

It will be observed that the problem is now comparatively simple; *A* and *V* are known or can be measured, and *K* is the only unknown factor which must be estimated, or otherwise determined. *K*, as already stated, is the *Intricacy* or *Finishing Factor* of the pattern, that is to say, its comparative intricacy, as to cores and loose pieces, hollows and projections, etc., which will make the mold harder or easier to finish and close. It is practically dependent on shape alone, not size. Thus, if *K* be known for a 3-foot diameter sheave, it is known for all sheaves of the same general form regardless of size.

The Intricacy Factor

It readily will be seen that by a series of careful time studies a table can be compiled of the values of *K* for a few patterns, typical of those in common use in any given foundry, and the value of *K* for any particular pattern can be determined easily and quickly by comparison with these landmarks. This has been done in the foundry in which the writer is employed, and a few days practice enables an assistant to set rates, with a high degree of accuracy, on a very large percentage of the varying patterns in use.

It will doubtless be argued that if *K* has to be estimated, this method of rate-setting is no better than the personal judgment method. A little reflection, will, however, show that such is hardly the case. An inspection of the schedule of elementary operations in the imaginary example taken will show that out of the 14 operations, only two, Nos. 10 and 12, have an intimate connection with *K* and four others, Nos. 2, 7, 9 and 13, bear only a slight relationship to *K*. Similarly, only one term out of four in the formula contains *K*. Any error in estimating *K* will, therefore, only affect the final result partially, the remainder of the time being known absolutely. On the other hand, an estimate based on the personal judgment method must, unconciously, cover all the variables mentioned, with the consequent possibility of error in the estimation of each.

It must not be imagined that the inference is intended that the proportion of elementary operations and terms affected by *K* is a full measure of the effect that the intricacy of the pattern has upon the whole molding time, though this is actually true in a large number of instances. But the intricacy of the pattern has, in fact, less bearing on the

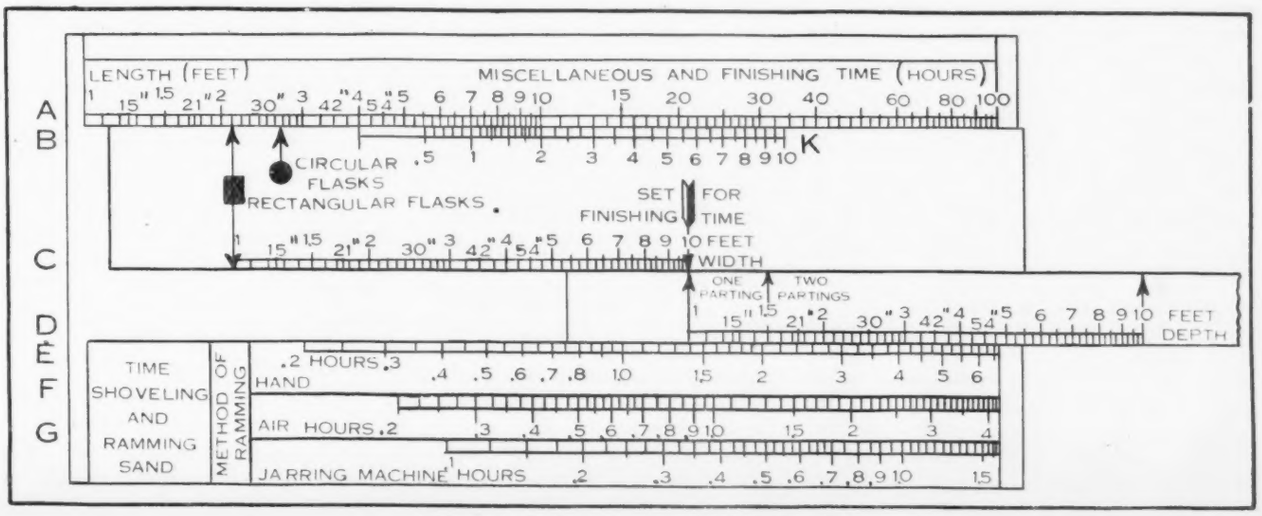


FIG. 2—SLIDE RULE IN FINAL POSITION

total molding time than might be at first supposed. It is, to a considerable extent, overshadowed by the heavy work of shoveling and ramming so many cubic feet of sand, and the miscellaneous items of clearing floor, clamping, rolling-over, etc., none of which has any relation to the shape of the pattern.

In this connection, it may be of interest to state that when the slide rule was first introduced, the foundry superintendent was politely skeptical and the foremen of both the iron and steel foundries openly ironical over the idea of setting rates by rule on such intangible work as molding. However, after a few demonstrations, all three asked to be given slide rules for their own personal use.

A few words on the average values of *K* may be in order. As will be seen from the illustrations, provision is made for a possible variation in the comparative intricacy of patterns from 0.5 to 10 or a range of 20 to 1. In practice, however, although our foundry handles many intricate patterns, 6.0 is the highest value we have yet had to use, this value being correct for double engine cylinders with two cylinders, steam chest and steam and exhaust passages cast in one piece. The average value of *K* for all patterns handled is around 1, and its value probably does not exceed 2 for 75 per cent of all patterns commonly used.

The formula, as given, cannot be used in connection with a logarithemic slide rule, but a simple modification renders it suitable. A rule based on such a modification, is shown in Figs. 1 and 2.

The Formula Explained

There are seven scales marked respectively *A* to *G*. Of these, *B* and *C* are on one slide, *D* on a second slide and the others on a fixed base; *A*, *C* and *D* are graduated in feet representing respectively the lineal dimensions of the flask. The graduations on *A* also represent hours. Scale *B* provides for *K*, while *E*, *F* and *G* are all graduated in hours, each scale standing for a different method of ramming the mold.

The answer is obtained in two parts. One from scale *E*, *F* or *G*, as the case may be, which gives the time for shoveling the sand and ramming the mold. The other from scale *A*, which gives the remainder of the time. These two must be added together to obtain the total time.

To use the rule, set the arrow of scale *B* against the length of flask on *A*, and the arrow of *D* against the width of flask on *C*. Then hold the small slide stationary while the large slide is brought back until the arrow of *C* and *D* are opposite each other. Then read the time required for shoveling and ramming sand on the correct scale *E*, *F* or *G*, beneath the depth of the flask on *D*, and the finishing time on scale *A*, over the correct value of *K* on scale *B*.

If the flask is circular its diameter will take the place of length on the *A* scale and width on the *C* scale and the arrow on *B*, marked *Circular flasks* should be used.

If the flask has two partings, the large slide must be set in the final setting with the arrow on *C* opposite the arrow on *D* which is marked *Two Partings*.

The two illustrations give the settings necessary for the solution of a problem in which the flask is 6 feet long, 3½ feet wide and 3 feet deep, with one parting. Fig. 1 shows the first setting of both slides and Fig. 2 the second setting after the larger slide has been brought back to its final position.

Figuring the Intricacy Factor

If the pattern had an intricacy factory of $K = 1.25$ and the mold were air-rammed, we read the *Miscellaneous and finishing* time on scale *A*, Fig. 2, over $K = 1.25$, to be 7.75 hours and the *Shoveling and ramming* time on scale *F*, below 3 feet deep on scale *D*, to be 2.6 hours, making a total of 10.35 hours for the whole job.

If the mold had been hand-rammed we would have used scale *E*, instead of *F* and the ramming time would have been 4.15 hours, making a total of 11.90 hours for the job.

The particular rule shown is graduated to read in *Premium Time Limits* direct, that is, a certain percentage has been added to the proper time, but it could be arranged instead to give the actual time that the work should take which would be required for setting bonus or piecework rates.

In conclusion, it may be said, that no claim is made for the discovery of an exact mathematical solution of all foundry time problems. In the first place, the formula on which the rule is based is empirical and therefore, only approximately correct and capable of improvement. In the second place, it does not profess to cover the entire field of foundry work; but it is claimed that the slide rule, when intelligently used within the range for which it is built, does give results that are more correct and uniform, and that with an expenditure of less time, than is possible under the usual methods.

In the foundry referred to, this slide rule is applied to 80 or 90 per cent of the floor work and another formula, on the same principle, is applied to all machine-molding.

Influence of Heat on Castings

By W. J. Keep

Question.—We recently had quite a serious fire which damaged our machine shop and our tools, while somewhat broken, otherwise seem to be uninjured. The insurance adjusters claim that a small expenditure for repairs will be sufficient to cover the loss. Should we accept this proposition?

Answer.—It would not be wise to accept such a proposition. You cannot ascertain how much damage has been done until the machinery is used. The heat to which the castings or tools are subjected by a fire will result in cracks which cannot be seen until the tools are used. From your description of the fire the machines were red hot and as your building was probably flooded with water, you will undoubtedly be compelled to scrap a large part of your equipment. A casting heated to redness will increase in size from 1-16 to ⅛ inch per foot, and the growth is greatest where the casting has been subjected to the highest temperature. This, of course, will distort the tools. The cast iron parts of your machines will be injured to a greater extent than the steel parts. Recently, we purchased a tool which, it developed, had passed through a fire, and after a few days use the paint cracked off and disclosed a fracture in the bed plate. We also had an experience with the brazing of a cast iron head of a blanking press. When it was returned to us it was found that one side had increased ⅛ inch in length and it became necessary to machine the head to obtain a fit. This shows to what extent cast iron will grow when heated to redness. A one-inch square test bar, one foot long, heated a cherry red and cooled slowly will probably increase in length ⅛ inch. By repeated heatings you can increase the length from ¼ to ½ inch. It is common practice, when a casting is too small, to heat it to slightly increase its size.

The Mumford Molding Machine Co., Plainfield, N. J., has furnished a 24-inch jolt-ramming molding machine, having a capacity of 24,000 pounds, to the Canadian Rand Co., Sherbrooke, Quebec.

A Modern Brass Foundry and Its Equipment

A Description of the Lumen Bearing Co.'s Plant Which is Provided With Labor-Saving Devices for Economical Operations

ALTHOUGH the adoption of labor-saving devices and the substitution of scientific accuracy for the time - honored rule - of - thumb methods in metallurgy have proceeded more slowly in the brass foundry business than in the iron and steel industries, considerable progress has been made in the past few years in this direction and at present, in the larger brass foundries, chemical and testing laboratories have been installed and are considered essential to the economical management of these plants. The value of analytical chemistry in the founding of copper and its alloys is thoroughly appreciated by the Lumen Bearing Co., Buffalo, and a well-equipped laboratory and testing department form an important adjunct to these works. This company also operates a branch foundry in Toronto, and conducts an extensive jobbing business, covering the entire range of the non-ferrous alloys.

The main plant in Buffalo is located at Sycamore street and the Belt line railroad, on a plot of ground, bounded on one side by the street, and on the other by the railroad tracks, which at this point are elevated. The foundry building parallels the tracks and is situated at the extreme rear end of the site, being connected to the street by an addition, which extends at right angles and in which the offices and several departments of the foundry are located. The general arrangement of the buildings is illustrated in the plan view, Fig. 1. The foundry is 272 feet long, 58 feet wide, and consists of a single bay surmounted by an open girder roof. The greater part of the building is one story in height, an increase to two stories being made at the juncture of the annex.

Plant Layout

Ample light and ventilation are provided by skylights in the peak and eaves of the roof, by numerous windows and the use of glass in the construction of the gable end of the one story portion of the foundry, as illustrated in Fig. 4. The extension that connects the foundry with the street is 110 feet long, and consists of two separate sections, one 44 feet wide, one story in height, including a basement, and the other, 28 feet wide and two stories high. At their juncture with the foundry, the two buildings are bridged by a platform which constitutes the shipping and receiving dock, and is connected to the street by a driveway.

The blacksmith shop, coke and sand storage bins, babbitt department, lumber, skimmings and flask storage are housed in individual buildings, which form a continuation of the two-story end of the foundry, and impart to the general layout of the plant the form of a T. The core department is located in the two-story end of the foundry, and is separated from the molding floors by a low dividing wall. The casting cleaning, sand blast and inspection departments are located in the one-story extension to the foundry, and in the rear of the offices. The machine shop and shipping room occupy the ground floor of the two-story extension, which is a fireproof building of steel and concrete construction, the second floor being used as a pattern storage. To provide space for the pattern shop, laboratory and testing departments, an extension is built onto the pattern storage, which converts the upper floor of the two-story section into an L. This extends as a closed gallery into the two-story portion of the foundry. Underneath this extension, in the foundry, is located the office of the foundry foreman and time keepers, also the metal room, where the furnace charges are made. A portion of the store room, Fig. 11, is also under this extension.

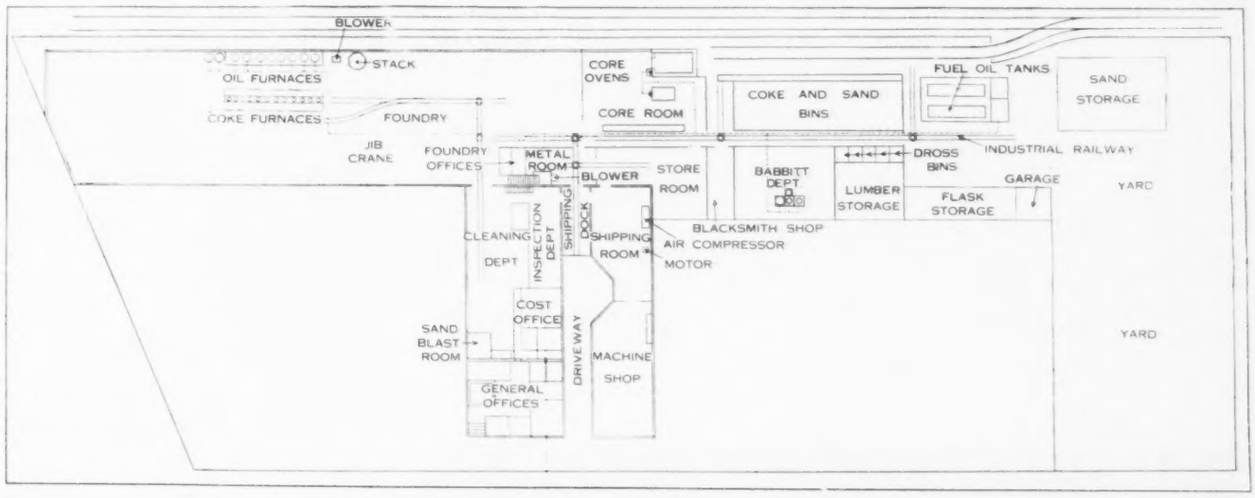


FIG. 1—GROUND PLAN OF THE FOUNDRY OF THE LUMEN BEARING CO., BUFFALO

The metal is melted in both oil and straight shaft, coke-fired furnaces, which are situated in a central position in the one-story portion of the foundry, and are placed in two rows with the oil furnaces near the wall. There are 10 oil furnaces in operation, all of the crucible type. This equipment consists of two Steele-Harvey tilting furnaces, installed by the Monarch Engineering & Mfg. Co., Baltimore; two furnaces built by the Anthony Co., New York, and six furnaces manufactured by Alfred Fisher, Chicago. The tilting furnaces each take a crucible holding 750 pounds of molten metal, but the other oil-fired

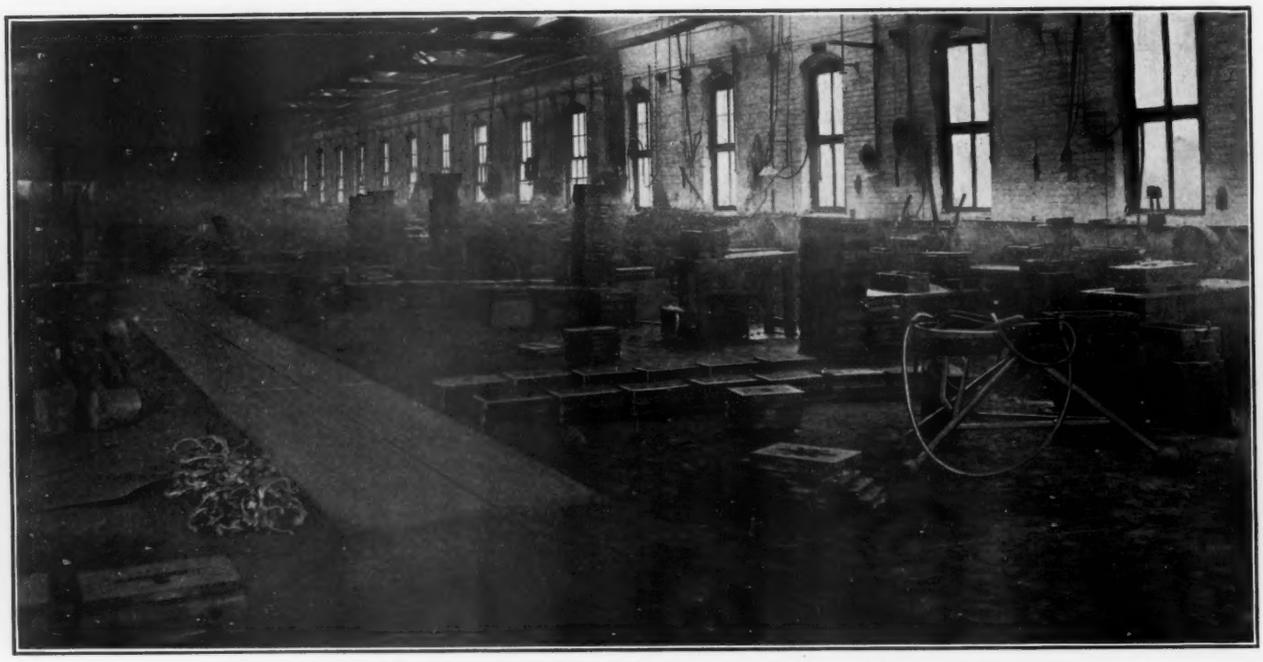


FIG. 2—A VIEW OF THE BENCH MOLDING FLOORS

furnaces use considerably smaller pots. The Anthony furnaces run on 4 ounces of blast, and the Fisher furnaces require 16 ounces. There are 12 straight shaft, coke-fired furnaces, six, 20 inches, and six, 24 inches in diameter. The largest pot used in the coke furnaces has a capacity of 1,200 pounds of molten metal. The combined daily capacity of all the furnaces is 14 tons, and of this total, as high as eight tons have, at times, consisted of manganese bronze. The average amount of metal actually turned out closely approaches these figures. The fumes from the oil furnaces are carried off by the sheet iron hood, *A*, Fig. 3, which is equipped with sheet iron stacks, 40 inches in diameter, and sufficiently high to draw off the gases.

Two of the oil furnaces are used for melting yellow brass, and the zinc oxide smoke is carried off while melting, by the swinging goose neck, *B*, Fig. 3, the hinged end of which enters the chimney. In this illustration the goose necks are shown in position over the charging hole in the cover of the furnace, and when not in use, are swung aside parallel to the wall. The coke furnaces are of the natural draft type. They are connected to a flue which communicates with a brick stack of a height sufficient to produce abundant draft. The flue back of the furnaces is raised several inches above the floor of the shop, and forms a convenient place for the storage of the crucibles in daily use. The transportation of metals and materials is accomplished by an industrial railroad system, which extends from the furnaces to the yard, and is connected by turntables, with the cleaning department, shipping dock, metal storage, store room, the coke storage and the railway side track.

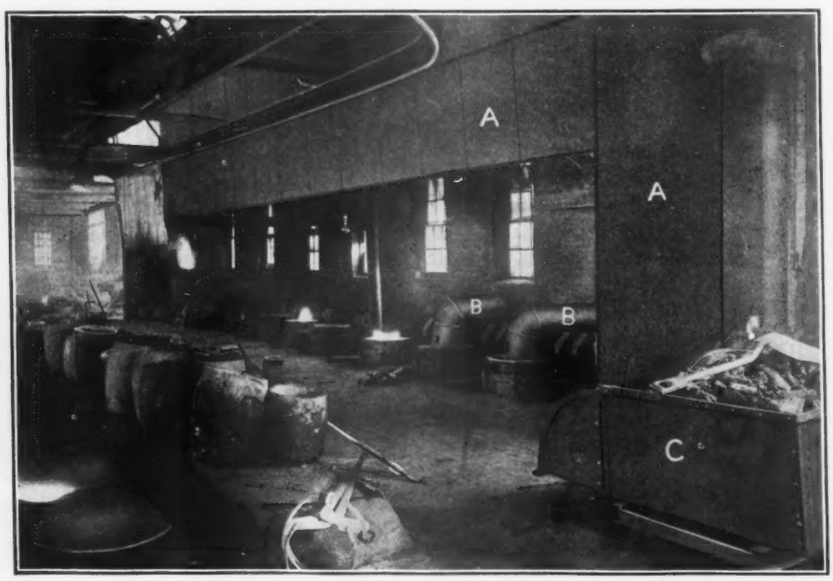


FIG. 3—THE TWO ROWS OF FURNACES, SHOWING THE HOOD OVER THE OIL FURNACES, THE COKE CAR AND OVERHEAD TROLLEY SYSTEM

Crane Equipment

The coke storage is located in the yard and this fuel is conveyed to the furnaces in an open-side, steel car, shown at *C*, Fig. 3. This car is stationed on a side track at right angles to the furnaces while the coke is being used. A complete overhead trolley system extends to all parts of the shop and affords a means for pulling-out the pots from the coke furnaces. In addition to the trolley system, there are three jib cranes and one traveling crane. The latter serves the two-story section of the foundry, and is hand-operated from the floor. This crane is equipped with two traveling, three-ton hoists. The jib cranes are located in the one-story part of the shop, and two serve the oil furnaces, while the other is adjacent to the coke furnaces, and includes in its radius a portion of the molding floor. It is, therefore, available for handling heavy molds, and for pouring-off heavy castings. A view of this crane is shown in Fig. 5. The majority of the heavy castings are made in the

FIG. 4—THE MACHINE MOLDING FLOORS, SHOWING THE SKYLIGHTS IN THE ROOF

two-story section of the foundry served by the traveling crane, the two hoists of which are available for pouring molds from two pots at one time. The metal is transferred from the crucibles to the ladle by the trolley system, and the pouring off is done either by the traveling hoist or jib crane, which swings the ladle from the buggy over the mold.

Continuous Casting

Pouring-off is continuous throughout the day, and is accomplished by three crews. The first pot is pulled at 8 a. m., and casting proceeds until 5:30 in the evening. Fig. 4 is a view of the machine molding floors, taken from a point just beyond the jib crane in Fig. 3. The floors in the foreground are directly in front of the coke furnaces, the piled metal charges for which are shown at the left of the illustration. The coke bins in the center carry the fuel supply for the furnaces at the opposite end of the row from which the car is stationed. Another view of this part of the foundry, taken from the opposite end of the shop, is shown in Fig. 2. The molding machine equipment comprises 12 machines of the squeezer type, installed by the Tabor Mfg. Co., Philadelphia, and the Berkshire Mfg. Co., Cleveland, and one Tabor power rammer. Some of these machines are operated continuously on trolley wheels for electric railway service, and in this connection it has been found more economical to use cores for forming the groove in these castings, than to make them of green sand and to roll the mold twice. The molds are poured-off, the castings taken-out and the sand is prepared by helpers, thereby increasing the output by relieving the molders of this work. The sand is riddled by shakers, installed by the Hanna Engineering Co., Chicago.

Making the Charge

The metal charges for the furnaces are weighed in the metal room which adjoins the store room for the reserve supply of metals. The metal room is connected to the store room and the foundry by the industrial railway over which the scrap, gates and risers are brought from the cleaning and inspection departments for storage. Sufficient new metal for the day's run is stored in the metal room, and the white metals for the mixtures are cut into convenient small pieces for making the weights. The copper charge, the gates and other returned metal, are placed, together with the mixture, ready for the melters and in this manner the charges can be kept absolutely uniform, as the amount of copper, returned metal, and the mixture therefor, is the same for each heat. An accurate record is kept of all the metals used in the mixtures, the weights being entered in a day book and are balanced against the metal on hand. In the store room adjoining the metal room, Fig. 11, the reserve supply of new metals are stored, also the shop supplies and the various ingot metals which constitute

FIG. 5—ONE OF THE HEAVY MOLDING FLOORS, SHOWING THE JIB CRANE AND A HEAVY MANGANESE BRONZE CASTING

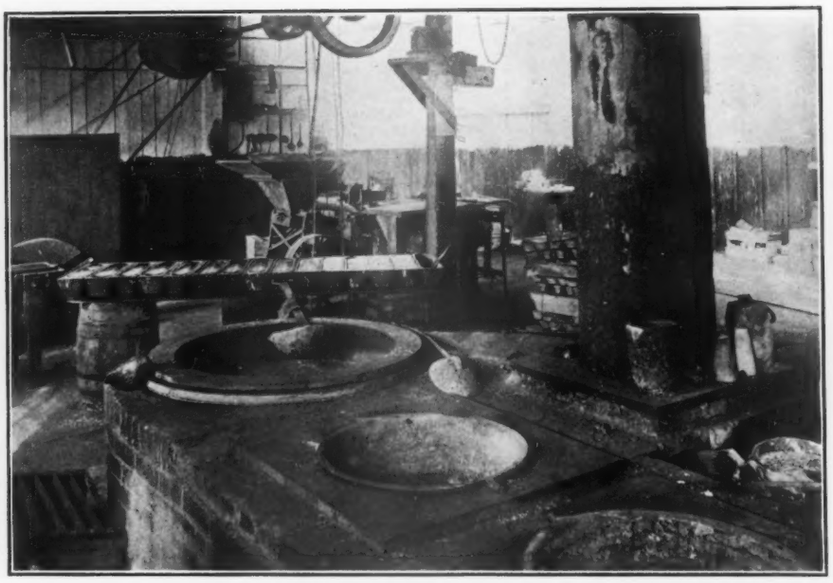


FIG. 6—A VIEW IN THE BABBITT ROOM, SHOWING THE 2-TON KETTLE

a part of the manufactured product. The new metals are received in carload lots, and are transferred from the side track to the storage department in cars operating on the industrial track.

The heating and ventilating plant is located in the metal room and consists of the usual equipment of heater coils and blower with distributing pipes extending to all parts of the plant. This installation was made by the American Blower Co., Detroit. Adjacent to the store room is the shipping department, which also constitutes a storage for the finished castings prior to shipment. A section of this department is set apart for the air compressor, which is driven by a 40-horsepower motor, and has a capacity of 240 cubic feet of free air per minute, at a pressure of 80 pounds. The compressor was installed by the Ingersoll-Rand Co., New York. The shipping room is equipped with two doors to facilitate shipping and receiving, and is connected to the other departments of the plant by the industrial railway.

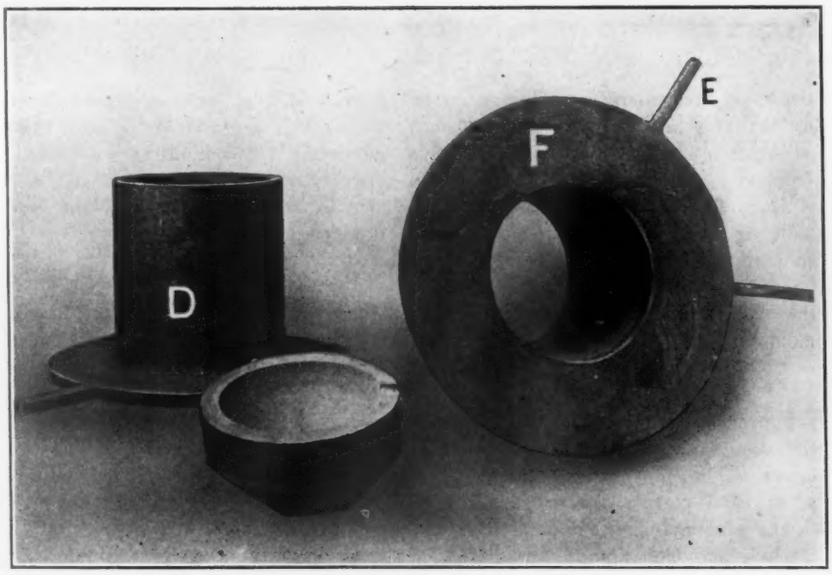


FIG. 8—MANGANESE BRONZE CASTINGS READY FOR SHIPMENT

FIG. 7—ANOTHER VIEW IN THE BABBITT ROOM SHOWING THE COOLING TANKS AND METHOD OF POURING THE INGOTS

Pattern Shop

The pattern shop is located above the metal room and metal storage and is equipped with two lathes, band saw, drill press, circular saw and planer. Adjoining the pattern shop, but separated therefrom by a fire wall, is the pattern storage vault, a view of which is shown in Fig. 13. One side of the vault is lined with shelving divided into pockets, about 18 inches square, which are lettered and numbered to facilitate the location of the patterns. When a pattern is received, its description is entered in a day book, which is posted daily in another book corresponding to a ledger. The pages of this book are divided into columns, headed, *Customers' Pattern Number, Our Pattern Number, Core Box* and *Date Returned.* To locate a pattern, it is only necessary to turn to the ledger, where the customer's name is entered, and here will be found the pattern number and a record of its location in the pattern storage. The core boxes are stored with the patterns. Metal patterns on plates are stored in an iron rack, and are located by means of zinc tags attached to the various sections. Patterns fitted with hard matches are stored in racks with the matches.

The Machine Shop

Underneath the pattern storage is the machine shop, which is equipped with a number of machine tools for brass finishing and comprise a disc grinder, planer, three turret lathes, a large engine lathe, several drill presses and a board drop hammer. In this department, trolley wheels of the built-up type

are made. These wheels consist of a copper or bronze core, combined with stamped flanges of soft steel, stiffened by a bead on the outer rims. The tread and the hub of the wheel are bronze castings, and they are first stamped under the drop to straighten them and correct any variation in the thickness of the casting. The next operation is to machine the tread and to bore out the hub. The flanges are then fitted in place, and the hub is burred over in the lathe, under sufficient pressure to solidly rivet the hub and flanges together and make a practically solid wheel.

Casting Cleaning Department

A view of the casting cleaning department is shown in Fig. 12. The castings are conveyed from the foundry into the cleaning department over the industrial railway, one of the cars containing a large casting being shown in this illustration. The casting cleaning equipment consists of two sprue cutters, one

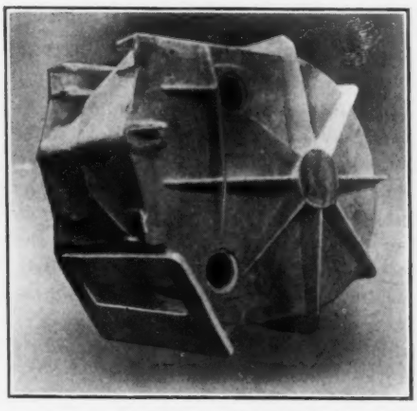


FIG. 9—A LARGE ALUMINUM CASTING THAT REQUIRED COMPLICATED CORES

installed by the J. D. Smith Foundry Supply Co., Cleveland, and the other by Benj. Middleditch, Detroit; two band saws and five stands of emery wheels. The latter, as shown in the illustration, are equipped with exhaust hoods. At the farther end of the clearing room is the sand blast room, which is equipped with one open end, tilting sand blast tumbling barrel, installed by the J. W. Paxson Co., Philadelphia. Large castings are sand-blasted on a grating equipped with an exhaust.

The inspection of castings is one of the important features of the work of this plant. All castings are ground and cleaned before inspection, which consists of a careful watch for defects, both hidden and obvious. The work is done by men, especially trained, and all castings are calibrated for the correct location of the cores and conformity to pattern. The inspectors are furnished with the blue prints of important work, to enable them to check up the sizes.

FIG. 10—A VIEW IN THE CORE DEPARTMENT

A device by means of which the works' manager can ascertain at a glance the progress of work through the various departments, is hung outside of the office of the chief inspector. It consists of a series of blackboards, each equipped with rows of small hooks. The top of each column of hooks is labeled, respectively, *Order, Remarks, Pattern, Foundry, Machine Shop* and *Shipping.* Each order is represented by a small card, which contains all the data regarding the work. This card is hung upon one of the hooks in the column headed *Orders,* and any unusual features of the order are entered on another card, which is hung on the same horizontal line of hooks under the heading *Remarks.* These two cards remain on their respective hooks while the work is being done on that particular order, and the progress of the work is indicated by another small blank card which is moved across the board and shows the progress of the work by its position. Thus, if the castings are being molded, the card will be suspended under the foundry heading, and if the work has passed to the machine shop or shipping department, the white card will indicate the fact by its position under these respective headings. Each card moves across the board until the job it represents is finished. A yellow card in place of the usual white one signifies that the job is held up and a red card, that it is a rush order.

The basement underneath the inspection department is subdivided and is fitted up as a lavatory and locker room

FIG. 11—A CORNER OF THE METAL STORAGE ROOM

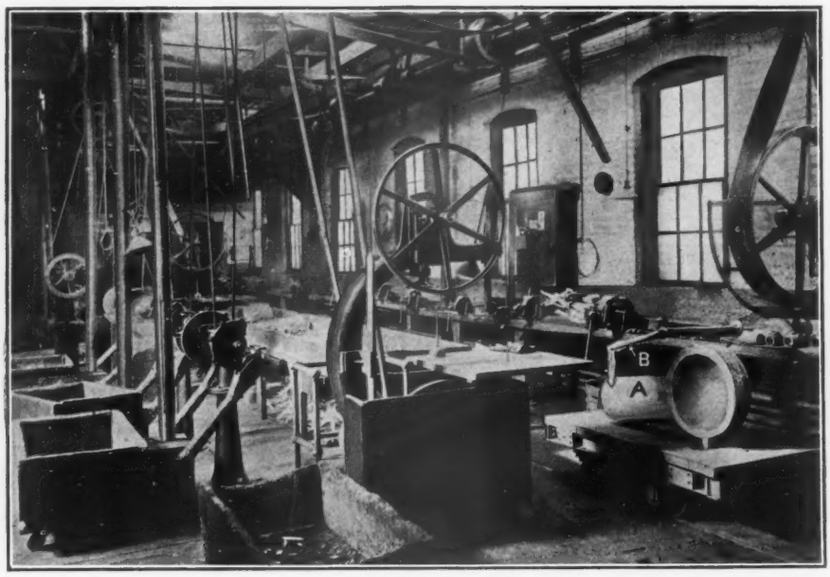


FIG. 12—THE CASTING CLEANING DEPARTMENT

with an attendant in charge. There are 157 steel lockers arranged in rows, installed by the Terrell Equipment Co., Grand Rapids, Mich.

Core Department

The core department occupies one end of the two-story portion of the foundry, a view of which is shown in Fig. 10. It is separated from the molding floors by a low fence, against which the coremakers' benches are arranged. This section of the shop is a continuation of the heavy molding floor and is served by the traveling hoists. The low division wall offers no obstruction to the transportation of cores and material from one end of this section to the other. In the illustration, a large core is shown suspended from one of the hoists. The cores are dried in two ovens, the location of which is shown in the ground plan, Fig. 1. The large oven is equipped with a car and the small oven is of the sectional door type and is used for drying the small cores. Both ovens are heated with fuel oil and are equipped with burners of the Fisher type. The temperature of the ovens is measured by a recording thermometer, furnished by the Bristol Co., Waterbury, Conn. The temperature of the ovens averages about 500 degrees Fahr. Stock cores are made by two core machines, manufactured by the Brown Specialty Machinery Co., Chicago, and the core sand is mixed and prepared by a core sand mixer, installed by the Wadsworth Core Machine & Equipment Co., Akron, O.

The babbitt department is located in a separate building at the rear of the foundry. The melting equipment consists of one 4,000-pound and two 1,000-pound oil-fired kettles, views of which are shown in Figs. 6 and 7. Babbitt metals are made that cover every requirement from the copper-hardened tin, antimony alloys to the various grades of anti-friction metals having lead as a base. Linotype and other grades of standard type metals are also manufactured, as well as solders of various compositions.

A specialty is made of an aluminum solder, which is cast into thin, triangular sticks in an iron mold consisting of two parts, one filled with triangular, parallel grooves, and the other a flat slab of iron which forms the cope of the mold. The mold is clamped and poured on end, and the grooves into which the metal is run to form the sticks, are all filled at once from the ladle by means of a heavy, horizontal runner, extending as a channel across the top of the mold.

The ingot molds in which the babbitt is run, are water-cooled. This is accomplished by the tank, *A*, Fig. 7, in which the molds are arranged on two parallel iron bars which extend from end to end of the tank, just below the surface of the water. The bottoms of the ingot molds are submerged and the depth of their submersion can be varied by increasing or decreasing the height of the overflow pipe. This method of water-cooling the molds has been found more satisfactory than the use of water-jackets. Several different types of ingot molds are used and the form of the ingot varies according to the grade of metal. The alloys are cast into rectangular, notched, and cylindrical ingots, and a new type of ingot, shaped to fit the babbitt ladle and consisting of a half sphere, is also made.

In making copper-hardened babbitts, the copper is melted in the crucible furnaces in the foundry, and a hardening is formed by adding the antimony and a certain proportion of tin, to make an alloy sufficiently fusible to dissolve when added to the balance of the mixture first melted in the babbitt kettles. When all the metals forming the alloy are melted, the bath is thoroughly stirred to produce a homogeneous mixture, after which the metal is poured into ingots in the manner shown in Fig. 7.

In one corner of the babbitt department a magnetic separator has been installed for cleaning brass borings.

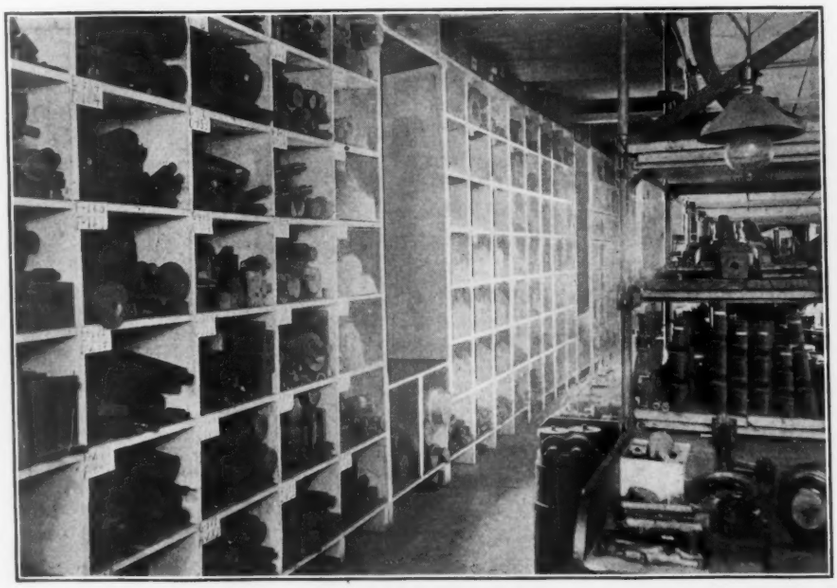


FIG. 13—A CORNER OF THE PATTERN STORAGE, SHOWING THE METHOD OF STORING SMALL PATTERNS

An alligator shear is used for cutting stock into small pieces to make up the weights for the metal mixtures. In the rear of the babbitt department, is the lumber storage and a series of bins in which are stored the skimmings and other copper-bearing refuse. There are five bins for this material in which the refuse from the different metals is separately kept. One bin contains the skimmings from the manganese bronze, others from the red brass, yellow brass and babbitt skimmings. This material is sold to the smelters on an assay of the copper contents; thus, the expense of installing and the cost of operating a recovery plant is obviated.

The sand and coke bins, Fig. 1, parallel the babbitt department, being separated therefrom by an alley through which are extended the tracks of the industrial railway, which is also connected by turntables to spurs at either end of the storage bins. Thus, three sides of this structure can be reached by the industrial railway, and on the fourth side is the railroad side track, from which cars can be unloaded directly into the storage bins, or into the shop cars for transportation to the foundry.

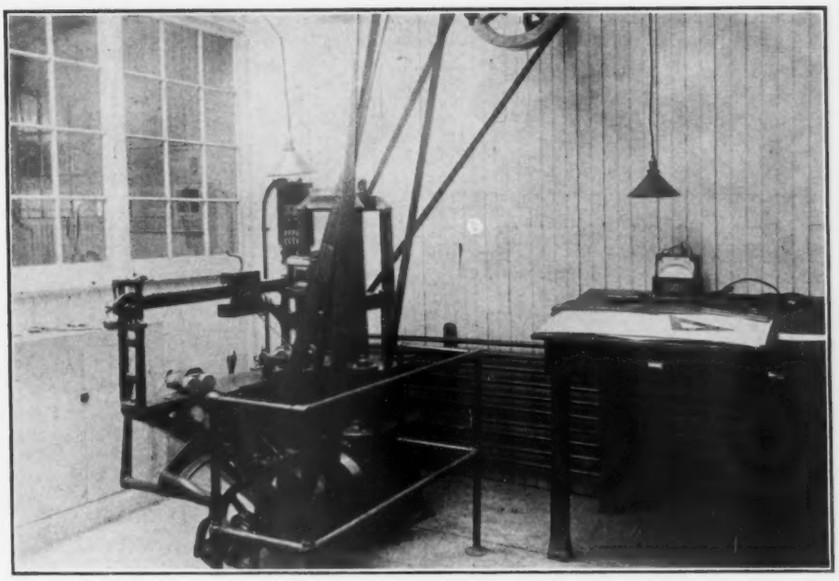


FIG. 15—THE TESTING DEPARTMENT, SHOWING THE 50,000 POUND OLSEN TESTING MACHINE

Oil Supply

The fuel oil is stored in two 6,000-gallon tanks, located in the yard in the rear of the coke bins. The tanks are in a concrete vault below the level of the ground. This vault is covered and in one corner, partitioned off by a concrete wall, have been installed an air compressor and oil pump, Fig. 17, both motor-driven. A 1,000-gallon service tank is also in this vault. The oil is pumped from the large tanks to the service tank, where it is subjected to sufficient air pressure to force it through all parts of the circulating system. The pressure on the oil, 30 pounds, is kept constant by the automatic regulation of the air compressor. The motor installation is isolated from the tanks, as a precautionary measure against fire. The oil is conveyed to the furnaces by a pipe line that is carried underground through the yard, to the end of the foundry building, as shown in the plan, Fig. 1. The oil pipe is 2 inches in diameter, up to the point where it is tapped for the babbitt furnaces. Here it is reduced to 1½ inches up to the source of supply for the core ovens, from which point a 1¼-inch pipe extends to the furnaces. Between the furnaces and the storage tanks five automatic stop valves are interposed. These valves and the entire oil supply system were furnished by the Lalor Fuel Oil System Co., Philadelphia. The valves automatically cut off the supply of oil in the event of a breakage of the oil lines or an abnormal flow to the burners. The valves are designed to operate on pressures ranging from 10 to 300 pounds without adjustment. It is claimed that in the event of a break in a 1-inch pipe line with a pressure of 20 to 300 pounds, the valves will close with a loss of oil not exceeding a few ounces. Fig. 17 shows a plan of the installation as applied to the oil tanks. In the plan, Fig. 1, the extension of the pipe line to the points of consumption is indicated, as well as the location of the various valves.

FIG. 14—A VIEW IN THE CHEMICAL LABORATORY

Foundry Product

The output of the foundry consists largely of jobbing work, although a specialty is made of trolley wheels, solid and built-up, as well as die castings for bearings and other machine parts. A large number of different alloys are made and castings are produced in manganese bronze, phosphor bronze, acid bronze, lumen bronze, red and yellow brass, white metal and aluminum. A large aluminum casting is shown in Fig. 9, which involved skillful molding and coremaking to obviate shrinkage, draws and cracks. The interior of the casting is divided

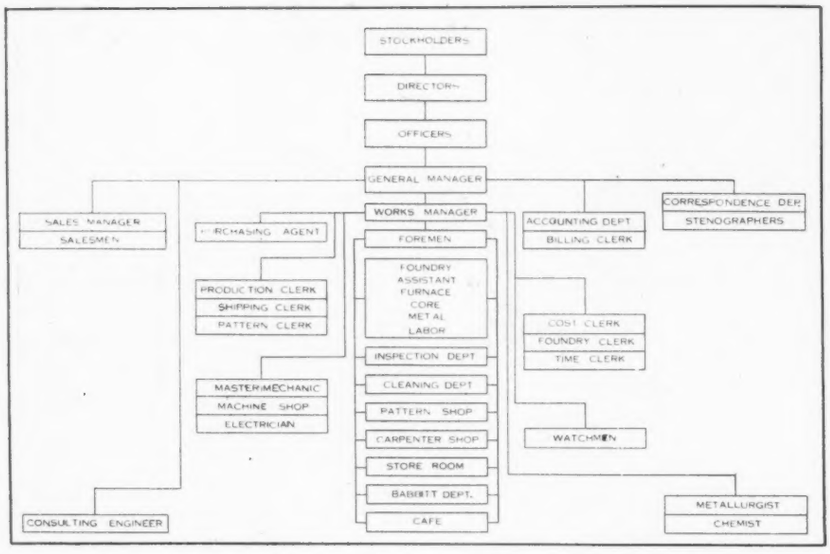


FIG. 16—ORGANIZATION CHART OF THE LUMEN BEARING CO

into numerous compartments and required intricate cores.

The proper casting temperature of the aluminum is ascertained by a portable, indicating, electric pyrometer. This instrument was furnished by the Wilson-Maeulen Co., New York, and the recorder is set on a bench convenient to the furnaces. The metal is carried to the pyrometer instead of the pyrometer to the metal, and the temperature of the latter is obtained by the insertion of the thermo-electric couple in the crucible.

Large Castings

In Fig. 8 are shown several large manganese bronze castings. The bushings are molded with the flange down, in a three-part flask. They are gated at the bottom and two large risers are placed on top, on opposite sides of the casting. To chill the metal the whole inside of the cheek is nailed and the dotted appearance of the side of the casting shown at *D*, Fig. 9, is produced by the heads of the nails. The bowl-shaped casting in the foreground is a pintle bearing for the lock gates of the Panama canal. This bearing weighs 400 pounds and it required 1,000 pounds of metal to pour the casting. The large amount of extra metal was required to prevent shrinkage. A view of one of these castings while it is being shaken-out of the mold, is shown in Fig. 5. The casting is molded with the bowl down as at *A*, and *B* is the riser. The top of the casting is chilled to avoid shrinkage. The method of gating these castings is illustrated in Fig. 12, one of the castings being shown on the car in the cleaning room. The gate, *A*, is almost a square section. The metal enters underneath the riser through a small gate and a long runner, and while the metal is entering the mold, the dross is held back in the riser by skimming, in the manner described on page 79, in the April, 1911, issue of THE FOUNDRY. The physical qualities of the manganese bronze castings are ascertained from the test bars, *E*, which are merely projections on the castings. These test bars are allowed to remain on the casting and are cut off in the presence of a representative of the purchaser. They are then tested and the results are an index of the quality of the metal in the casting. A tensile strength of over 80,000 pounds per square inch is not unusual.

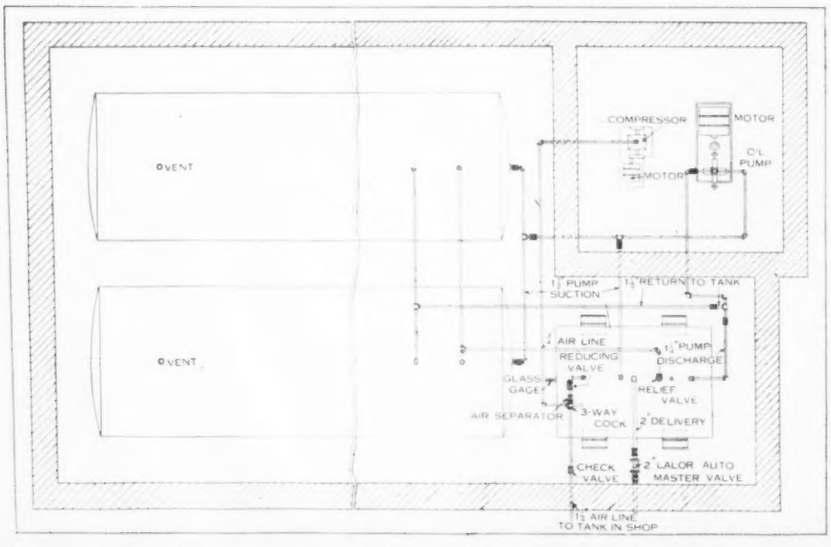


FIG. 17—PLAN OF THE OIL STORAGE AND SERVICE TANKS, SHOWING THE PIPING, MOTOR CELL AND THE LOCATION OF THE AUTOMATIC SAFETY VALVES

Lumen Bearing Bronze

One of the most interesting of the numerous alloys manufactured by the Lumen Bearing Co., is a hard and strong white metal composed of zinc alloyed with copper and aluminum, and from which the company derives its name. This alloy has the following formula: Copper, 10 per cent; zinc, 86 per cent, and aluminum, 4 per cent. It was invented by Prof. R. C. Carpenter, of Cornell University, who named the new alloy lumen, meaning light in allusion to its color. The alloy was manufactured under the original patents by the Lake Smelting Co., Utica, N. Y., and in 1898, the firm of Bierbaum & Merrick was organized in Cincinnati to act as sales agents. This concern subsequently purchased the patents and in 1899 moved to Buffalo and organized the Lumen Bearing Co.

Die Casting Machine

As the new alloy was well-adapted for the manufacture of die castings, it was largely used for this purpose and in 1903, C. R. Bierbaum invented a die casting machine for casting axle bearings for electric cars. The essential parts of this machine are a pedestal surmounted by a bracket carrying a pivoted yoke, which is free to move in a vertical plane. The yoke is attached to a shaft equipped with a hand wheel at one end, and a mold at the other. By means of various levers and rods the shaft carrying the mold can be tilted at different angles. In operating the machine, the reservoir, *D*, Fig. 18, is first filled with metal, and the machine is tilted, causing the end of the mold remote from the gate to fill with metal first. During this process the mold is rotated uniformly, the tilting being increased

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

USEFUL INFORMATION FOR THE FOUNDRYMAN.

Specifications for steel castings for the hulls and hull fittings of vessels of the United States navy, recently issued by the bureau of construction and repair, are as follows:

Class	Material	Tensile strength pounds per square inch; minimum.	Elastic limit, pounds per square inch: minimum.	Elongation per cent in 2 inches; minimum.	Maximum phosphorus, per cent.	Cold bend about an inner diameter of one inch.
A	Any approved process	80,000	35,000	15	0.06	Through 90 degrees
B	Any approved process	65,000	30,000	20	0.06	Through 120 degrees
C	Any approved process	Surface inspection only, unless of doubtful quality.				

All castings shall be annealed unless otherwise directed. If the castings are subjected to any additional treatment, the inspector will make such additional tests as may seem necessary to determine if the treatment has injuriously affected the casting.

Sound test pieces shall be taken in sufficient number to exhibit thoroughly the character of the metal in the entire piece, from castings for the stem, stern frame, rudder frame, shaft struts or brackets, and from all castings weighing over 200 pounds. All other castings may be tested by lots, as follows: A lot shall consist of all castings from the heat annealed in the same furnace charge. From each lot two tensile and one bending samples shall be taken, the tests of which shall determine the acceptance or rejection of the lot. The specimens may be cut either from coupons attached to the casting, or from the pouring heads.

Castings for stems, stern posts, shaft brackets, turret roller tracks, bed plates, foundations and other important castings are subjected to a hammer test by being suspended by chains, and hammered all over with a heavy sledge hammer. No cracks, flaws, defects or weakness must appear after such treatment.

All castings must be sound, free from brittleness, injurious roughness, sponginess, pitting, porosity, shrinkage and other cracks, cavities, foreign substances, and all other defects affecting their value. Particular search must be made at the point where the heads or risers join the castings, as unsoundness at this point may extend into the castings. The bureau may, under special circumstances, permit the welding of surface defects, but authority to do this must be obtained in each case from the bureau through the inspector.

DATA SHEET No. 105, THE FOUNDRY, JANUARY, 1912.

USEFUL INFORMATION FOR THE BRASS FOUNDRYMAN.

For the purpose of securing uniformity in the quality of castings for use on naval vessels the following standard requirements for special alloys have been issued by the bureau of construction and repair of the United States navy department:

Manganese Bronze.

	Per cent
Copper	56.00
Zinc	41.38
Iron	1.25
Tin	0.75
Aluminum	0.50
Manganese	0.12

This alloy is used for the turning gear of turrets, the main gearing of the steering engine and other castings requiring great strength. The castings must be sound, clean, free from blow-holes, porous spots, cracks or any other defects. Individual test pieces are required for castings weighing over 200 pounds, while castings of less weight are tested by lots.

The test pieces shall show an ultimate tensile strength of not less than 60,000 pounds per square inch, an elastic limit of not less than 30,000 per square inch, and an elongation of not less than 20 per cent in two inches. The color of the fractured section of the test pieces, and the grain of the metal must be uniform throughout.

Tobin Bronze.

	Per cent
Copper	59.00
Zinc	38.40
Tin	2.16
Lead	0.31
Iron	0.11

Tobin bronze is most frequently used in the rolled condition, for purposes where great strength is required or in cases where the alloy is subject to corrosion by salt water.

Muntz Metal.

	Per cent
Copper	60.00
Zinc	40.00

This alloy is used for bolts and nuts, that are subjected to the action of salt water.

Anti-Friction Metal.

	Per cent
Banca tin	88.80
Regulus of antimony	7.50
Best refined copper	3.70

This alloy is used for all white metal lined bearings, and bearing surfaces. When practicable, the weighing and mixing of the metals comprising this alloy will be witnessed by a government inspector. Otherwise, as many chemical analyses will be taken as may be necessary to show that the alloy is of the proper composition.

DATA SHEET No. 106, THE FOUNDRY, JANUARY, 1912.

until the shaft makes half a revolution. When the mold is filled the machine assumes a horizontal position, the gate is detached, and the mandrel with the casting adhering, is removed. The casting is detached by a slight tap and the mandrel is cooled in water, before being reassembled in the machine ready for another cast. The principle that underlies the tilting and rotating movements of the machine is to produce a casting free from all dross contamination, by filling the mold in such a manner that all oxidation of the metal is avoided as it enters the mold. By the tilting movement that part of the mold to be filled first is placed in the lowest position and by the rotating movement the gate is moved as the mold fills and always remains in line with the molten metal in the mold. The metal is not disturbed when once deposited in the mold and the following new metal is deposited upon that preceding. By avoiding all agitation of the metal, oxidation is reduced to a minimum and a casting is produced without entrained scum.

Sections through the mold and reservoir are shown at *A* and *B*, Fig. 18. The reservoir is lined with asbestos board, which is soaked in water and firmly pressed into place. The seams are wiped with asbestos cement. The gate is lined in the same manner as the mold and is made flush with the front of the face plate, against which the heavy flange of the casting is formed. The lining of the gate and mold is thoroughly dried before using, and will last for several weeks. The face plate, *B*, Fig. 18, consists of a heavy copper collar, the chilling effect of which was found to be materially greater than that produced by a water-jacketed collar having comparatively thin walls. The mandrel is made of bronze, composed of copper, 92 per cent; tin, 4 per cent, and zinc, 4 per cent. Water-jacketing was at first tried, but failed as it caused sweating on the surface of the mandrel, resulting in defective castings and, in addition, caused the mandrel to disintegrate. Water-jacketing was, therefore, abandoned and dipping in water resorted to with satisfactory results.

The Laboratory

In Fig. 14 is shown a view of the laboratory. The equipment includes the usual table with hood and a complete outfit for making electrolytic analyses. This department consists of balance, testing and storage rooms. The testing room, Fig. 15, is equipped with a testing machine of 50,000 pounds capacity, installed by Tinius, Olsen & Co., Philadelphia.

The plan of organization of the Lumen Bearing Co. is shown graphically in the chart, Fig. 16. The entire plant is under the direction of the general manager. The works manager is next in authority and has supervision of the various departments engaged in the production of castings. William H. Barr is general manager; W. M. Corse, works manager; H. P. Parrock, sales manager; J. R. Huber, metallurgist; W. E. Warner, foundry foreman, and W. H. Inglis, assistant foundry foreman.

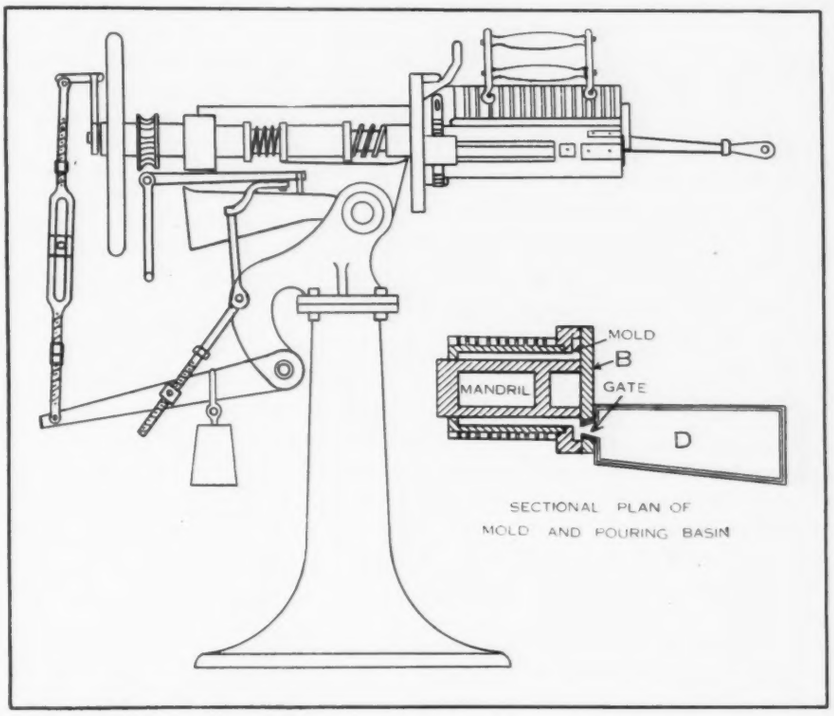


FIG. 18—A DIE CASTING MACHINE FOR AXLE BEARINGS AND A LONGITUDINAL SECTION THROUGH THE MOLD AND POURING BASIN

Fire Brick Tapping Hole

By W. J. Keep

Question:—We understand that you suggest the use of a fire brick breast in the cupola in preference to a clay breast. If you prefer the brick breast best will you kindly tell us what the advantages are?

Answer:—For a small melt, from 15 to 16 tons in 1½ hours, a clay breast will prove most satisfactory. For a long melt of 30 or more tons in 2½ or 3 hours, the clay breast will not last as well as the fire brick breast. On a long run the tapping hole in clay wears away rapidly and occasionally it breaks away entirely, permitting the iron to come faster than it can be handled. The hole must then be stopped and a new opening of the correct size must be worked through, but the breast is not as strong as before it was broken. It might, however, be considered an advantage to be able to vary the size of the stream. If the iron freezes in the tap hole another one can be easily bored. The clay breast is frequently made just before the blast is put on. This method of procedure permits air to enter the cupola both through the breast and the slag hole, which gives a hotter cupola than when all of the air enters the furnace through the tuyeres during the time the fire is being lighted. Hot iron depends more on a hot cupola lining when the blast is put on than on large charges of fuel. A clay breast is frequently put in with a finished tap hole in it, but this opening is usually quite large to permit of the admission of sufficient air during the time the cupola is being lighted. The large opening is, of course, closed just before the blast is turned into the cupola. The hole in the breast should be of sufficient size to permit a steady stream of metal to flow without plugging the opening. The molten iron in the cupola should be about 9 inches deep at the tap hole, while the stream is flowing. If the cupola is melting at a rapid rate, the increased head of metal will cause a more rapid flow, but if the rate of melting is slow, the stream naturally would flow proportionately slow.

The brick breast is 9 inches high, 4½ inches wide and 2¼ inches thick and contains two openings, ⅝ inches in

diameter, inclined toward the spout. These openings are 2½ inches apart. If the cupola is melting too rapidly, the iron can be tapped from both openings. The upper hole may be opened first and the iron can be tapped in this way until all of the molten iron in the bottom of the cupola is very hot; then the upper opening is closed and the iron is tapped through the lower hole in the breast. If the lower opening freezes, the iron can be tapped through the upper hole until the lower one has melted open. It is not safe to bore a new hole through the brick. If it cracks or becomes loose there is danger of the entire breast breaking away. There is a temptation for the melter to bore the tap hole in the brick too large and to reduce it to the desired size by the use of clay, a thing to be avoided.

Many melters believe that it is good practice to light a fire as late as possible and to charge the iron as soon as the fire becomes bright. Many cupola difficulties arise from this practice, as the cupola lining has not been raised to a melting heat before the blast is put on. In order to heat the cupola properly, the fire should be lighted at least 1½ hours before the iron begins to come down.

Brass Foundry Difficulties

SOLVED BY EXPERTS

Mixtures for Plumbers' Goods

We would like a high grade mixture suitable for ⅝ inch stop and waste cocks, and one containing scrap that can be used for smaller sizes.

A mixture of all new metals suitable for any of these castings follows: Copper, 85 pounds; tin, 4 pounds; zinc, 6 pounds, and lead, 5 pounds. A cheaper mixture, consisting largely of scrap, follows: Sheet brass clippings, 80 pounds; copper, 30 pounds; lead, 2½ pounds; tin, 2 pounds, and phosphor-copper, 1 pound. A still cheaper mixture that will turn out nice castings is composed of scrap copper, 96 pounds, heavy yellow brass scrap, 60 pounds, and lead, 5 pounds.

Babbitt Mixtures

We would like to obtain formulas for the following alloys: Babbitt lining for car journal bearings, low grade babbitt for low and high speed; and a brass mixture in which old scrap car brasses can be used.

Antimonial lead is the metal generally used for lining car journal bearings, and it can be purchased ready for use, or may be made as follows: Soft lead, 80 pounds, and antimony, 20 pounds; melt half of the lead and heat it to redness; then gradually add the antimony until it is melted when the addition of the remainder of the lead charge will cool the metal to a casting temperature.

A cheap, but excellent anti-friction metal contains the following: Lead, 80 pounds; tin, 4.75 pounds, copper, ¼ pound, and antimony, 15 pounds. This metal can be used for both high and low speeds where it is not subjected to excessive pounding. For service under the latter conditions a high grade tin babbitt must be used.

Scrap car brasses must be used with caution in any mixture as they are liable to contain oxides and iron. The use of more than 25 per cent of this scrap is not advisable. The new metal mixture may consist of copper, 60 pounds; tin, 7½ pounds, and lead 7½ pounds, to which is added 25 pounds of scrap. The further addition of 2 pounds of 30 per cent phosphor-copper is recommended.

Alloy for Bushings

We recently received an order for a large number of small bushings used for bearing purposes. The requirements of the service are severe and we would like to obtain the formula of a first class alloy suitable for the purpose.

The formula of an alloy that will meet the requirements specified, follows: Copper, 78 per cent; tin, 10 per cent; lead, 10 per cent, and phosphorus, 2 per cent. Add the phosphor-copper to the molten copper, before either the tin or lead; stir thoroughly, then add the tin and last, the lead. If not sufficiently hard, the phosphorus can be increased by using 4 per cent of phosphor-copper in place of 2 per cent and by decreasing the copper charge by this amount.

Mixture for Blast Furnace Tuyeres

Can you furnish us with a formula for blast furnace tuyeres and hot valve seats? The mixture must be nearly pure copper. Can a serviceable tuyere be cast from ingot copper without the addition of any other metal or chemical?

Pure copper cannot be cast in sand molds without the addition of some deoxidizing element, as the metal absorbs oxygen so readily that the castings will be full of holes, regardless of how carefully it is melted. The best deoxidizing element to use for making tuyeres is silicon, added in the form of silicon-copper. The best proportion to use for this class of castings is 2 pounds of 10 per cent silicon-copper to each 100 of melted metal. The silicon-copper should be added when the copper has reached a pouring temperature and after the addition of the silicon, the metal should be well-stirred, preferably with a graphite stirrer. An iron poker can also be used. It should be coated with a heavy wash of fire clay, thoroughly dried and afterwards heated before insertion into the metal.

Formula for Steam Metal

Will you kindly send me formula for a steam metal that will show a good color and not cost over 12 or 13 cents per pound at the present prices of metals?

The cost of the metal can be reduced to the figures named by the use of scrap. About 50 per cent of machinery scrap brass can be used and the other 50 per cent of the charge may be made up of new metal of the following formula: Copper, 85 per cent; tin, 5 per cent; zinc, 5 per cent, and lead, 5 per cent.

White Metal

We would like to obtain a formula for a white metal for small, artistic novelty work, which is suitable for casting in metal molds.

A suitable alloy for this purpose follows: Lead, 87 per cent, and antimony, 13 per cent. The metal should be as clean and free from arsenic as possible, and to attain this end a practice often pursued by metal casters is to cover their metal at night with coal ashes, which to some extent clean the metal.

THE BRASS FOUNDRY

Casting Works of Art in Bronze

By C Vickers

THE perpetuation of artistic objects by casting them in bronze has been practiced from the earliest ages and by many races of mankind. In the east the skill of the Japanese, Hindus and other Asiatic peoples is attested by the many exquisite vases, statuettes and other objects that have been handed down, while the remarkable creations of the ancient Greeks furnish ample evidence of the mastery of the western nations over this difficult branch of the founder's art. There is reason to assume, however, that the skill of the ancients in making difficult castings lay more in their ability to finish them when cast, than in the production of perfect castings. The fact that an ancient statue or vase is found to consist of one piece need not be taken as an indication that it was cast without blemish, or was even nearly as good as a similar modern casting would be expected to be. The ancient founders had abundance of time and could burn, chisel and scrape until all defects were filled and traces of gates, risers, etc., removed and the perfect work was ultimately handed down for the emulation of some modern founder who imagines the casting to have been as perfect as its appearance would indicate.

Owing to the conservatism of the eastern nations, the ancient methods of working have been, to a large extent, preserved, and this is notably the case with the casting of bronze. The highest point of development in this art was reached in Japan between the eighth and twelfth centuries, and the methods then developed have been continued to the present time. One of the most remarkable things about Japanese foundry practice, as applied to artistic objects, is the appearance of the casting when taken from the mold, as it seems to consist principally of holes, due largely to the remarkable thinness of the walls, which frequently make a complete filling of the mold impossible. As there is no economy in making a casting too thin to run, it is reasonable to suggest that the defects are largely caused by the faulty centering of the cores.

Burning-on by the Japanese

Whatever may be the cause of these defects, whether due to blow holes, dirt, scabs or misruns, they are ultimately plugged by burning, at which the Japanese workman is an adept. In making the burns, part molds are employed and sometimes wax patterns, and when the casting is completed it presents a most unsightly appearance, being frequently covered with from 50 to 100 burns. As might be imagined, the finishing operation is even more difficult than the burning, especially as it is largely done with a scraper and chisel, but when completed the casting has a wonderful polish, hardly a seam being visible. After it has been subjected to the far-famed Japanese coloring process, it is often difficult to detect the joints even after the lapse of centuries. In the case of the Daiboots, the ancient and enormous statues located respectively at Nara and Kamagura, Japan, although they are built-up of a large number of plates, they are so perfectly joined that it has taken centuries to reveal the seams, and even at the present time it is often difficult to distinguish the built-up parts. The manner in which the statue at Nara was constructed is minutely related by Japanese historians. It consists of bronze plates, about 10 x 15½ inches in size, which were cast in position, one after the other, in a manner similar to that followed by the modern plaster caster in making a piece mold.

FIG. 1—BRONZE STATUE OF ABRAHAM LINCOLN, MODELED BY F. E. ELWELL

Japanese Statues

The construction of these statues must have taken a long time, as the plates in the older parts of the statue at Nara are smaller than the newer portions, some of the latter being very large pieces, and the head, which was cast in the sixteenth century, appears to be in one piece, although from an artistic standpoint it is much inferior to other portions of the statue. The method adopted in making these statues is still practiced with some slight differences in Japan, and consist in first casting one small portion and then constructing another mold above or beside it and flowing the metal directly onto the partly cooled piece previously cast. This method naturally resulted in a very rough and faulty surface and it required great patience to remove the faults with chisel and scraper in order to produce the mirror-like surface these statues possess and which has lasted to the present day. There is.

FIG. 2—BRONZE SHOWING PULASKI ASTRIDE CHARGER; HEIGHT 15 FEET 4 INCHES AND LENGTH 16 FEET 4 INCHES

little doubt but that the artistic work produced at the present time is fully up to the ancient standards, for while the castings might not always be perfect, such defects as described would not be tolerated.

Modern Bronzes

Some fine examples of modern artistic bronzes are shown in the accompanying illustrations. The heroic bronze statue of General Hancock, Fig. 5, erected in Philadelphia, is a particularly fine example of the bronze founder's art. The height of this statue is 16 feet 8 inches, and it is 16 feet 3 inches long. The statue was modeled by J. Q. A. Ward and was cast by the Gorham Mfg. Co., Providence, R. I. Another striking bronze equestrian statue is that of the Polish hero, Pulaski, Fig. 2, erected in Washington, D. C. This statue is 15 feet 4 inches in height and 16 feet 4 inches in length. It was modeled by Kazimierz Chodzinski, and also was cast by the Gorham Mfg. Co. The statue of Lincoln, Fig. 1, was erected in East Orange, N. J. It is 9 feet 10 inches high and was modeled by Frank Edwin Elwell and was cast by the Gorham Mfg. Co. A view in the foundry of the Gorham company is shown in Fig. 6. The figures shown are the Puritan, John Paul Jones, August Belmont and Bryant. The statue of the latter was erected in Bryant Park, New York. The group illustrates work by the following sculptors: Herbert Adams, Max Bachman, A. Bainchini, Gutzon Borglum, E. E. Codman, William Couper, Eli Harvey, Henry H. Kitson, Theo. Ruggles Kitson, Frederick Kohlhagen, C. H. Niehaus, J. Q. A. Ward and Fred Packard.

Large, One-Piece Bronze

Another large statue of particular interest, in that the horse was cast in one piece, is that of General Sheridan, erected in Sheridan Circle, Washington, D. C. Usually, a casting the size of this horse, Fig. 3, is made in several pieces; the head and neck of the animal in one piece, the tail in another, the body in two parts and the four legs separately. The parts are then carefully riveted and braced together to give the appearance of being cast in one piece. The statue is 14 feet high and depicts General Sheridan in the act of turning to his fleeing soldiers at Cedar creek, after his historic ride of 20 miles from Winchester. It was modeled by Gutzon Borglum, the New York sculptor, who has produced a remarkably virile and dashing replica of the great soldier. The statue stands on a low granite pedestal and was erected at an expenditure of $50,000. More than 6,000 pounds of metal were required to cast the horse. The metal was melted in crucibles which were emptied into a large ladle; the entrance to the mold in the pouring basin was closed by plugs which were withdrawn when the basin was filled with metal. The flask in which the mold was made was about 12 feet long, 6½ feet high and 8 feet wide and weighed between 70 and 75 tons before the metal was poured.

Another remarkable bronze casting is that of the urn on the prison ship

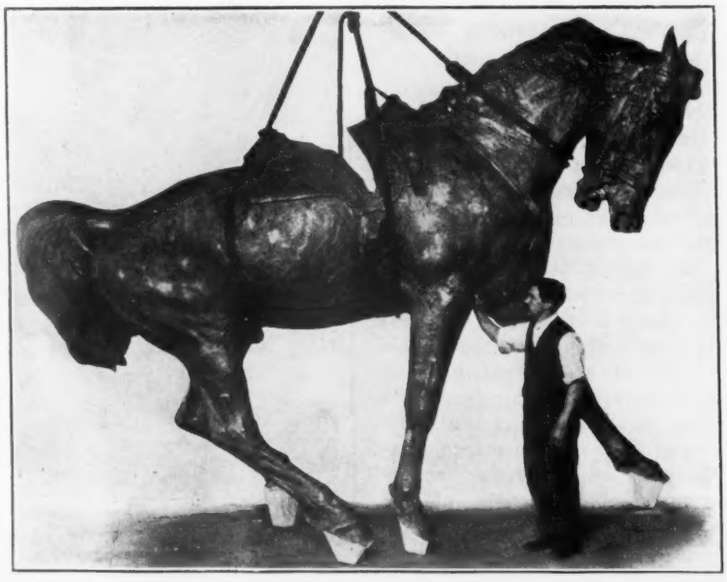


FIG. 3—BRONZE HORSE OF THE GENERAL SHERIDAN MONUMENT, CAST IN ONE PIECE

martyrs' monument, Figs. 7 and 9, which was erected in Fort Green park, Brooklyn, N. Y., over the graves of the Revolutionary heroes who perished in the prison ships of Wallabout Bay. The column is built of white granite, 150 feet in height and 18 feet in diameter at the base and 14 feet at the neck, and was designed by the late Stanford White and erected under the supervision of McKim Meade & White, New York. At the top the column spreads out into a 20-foot square. The inside of the shaft is hollow, the opening being nine feet in diameter and contains a winding stairway and an elevator. Surmounting the shaft is one of the largest bronze funeral urns ever cast. It is 22½ feet high, 12 feet in diameter, and weighs eight tons. Thirty-five men can comfortably stand in the bowl, which is supported on heavy sculptured and brazed uprights, topped with decorative lion heads two feet in diameter and weighing 100 pounds each. In making the urn, a full size model was built-up in plaster over a wooden frame, which, when completed, was placed on top of the shaft for the architect's final approval. The cost of the model alone was

FIG. 5—MAGNIFICENT BRONZE STATUE OF GENERAL HANCOCK

FIG. 4—GROUP OF ARTISTIC BRONZE ORNAMENTS

$1,000, and the total cost of the urn was $14,500. The cost of the entire monument was $437,000. After the model had been approved on its lofty site, patterns were made in plaster and wax, and after the castings were made they were taken from the foundry to the fitting department where they were brazed and riveted together in such a manner that they could be taken apart in sections for convenient transportation. The various parts of the urn were hoisted to the top of the shaft and there re-assembled, the entire bronze structure being anchored to the granite by heavy bolts set several feet into the stone. The artistic character of the castings that combine to make up this urn is indicated in Fig. 4; the eagle, 5, is one of four similar castings that ornament the top of the standard above the lions' heads, 1 and 2; another ornamental section is shown at 4, and 3 is a portion of the bowl of the urn assembled in the foundry; the ornamentation on the face of the bronze uprights is illustrated at 6.

Artistic Indian Group

Front and back views of an Indian group entitled "The Coming of the White Man", are illustrated in Figs. 8 and 10. This bronze statue was erected on the highest eminence in City Park, Portland, Ore., and represents the Indian chief, Multnomah, and a companion on a knoll overlook-

FIG. 6—A CORNER IN THE FOUNDRY OF THE GORHAM MFG. CO., PROVIDENCE, R. I., SHOWING A LARGE NUMBER OF BEAUTIFUL BRONZES

ing the Columbia river, catching the first sight of the approaching strangers, Lewis and Clark. This is one of the most artistic of the many Indian bronzes made in this country and is the work of Sculptor H. A. MacNeil. The statue was cast by Bureau Bros., Philadelphia. The Indian chief is nine feet high and this casting was poured in one piece, the mold having been made by the sand process, false cores having been employed. The companion of the Indian chief with the bough of a tree in his hand is also of heroic size, but slightly smaller than the chief. The casting of this figure, however, involved many difficult problems, as the draperies at some points clear the figure entirely, as shown in Fig. 10. The cloak falls away from the left arm of the figure, and in making the mold a number of inside cores were used. This necessitated careful work on the part of the molder, particularly in venting. These inside cores were entirely enclosed with metal and the molder was compelled to carefully arrange his runners, gates, etc. This group weighs only 2,500 pounds and the metal throughout the statue was exceedingly thin.

The most interesting feature in connection with the production of artistic castings, from the founder's point of view, is the manner in which they are molded. The castings that constitute the urn on the prison ship monument were not particularly difficult to make, as they were made in detail. Most of them can be made by ordinary methods of molding. Such castings as the lion's head, Fig. 3, are frequently made by coring-out the undercut portions, the cores being made in separate core boxes. Many seemingly difficult scrolls, shields and ornamental human and animal heads are made in this manner and after the pattern has been fitted with block prints and the core boxes are made, the castings can be duplicated the same as any ordinary casting. This method has been extensively employed in making architectural bronze castings, because it is more rapid than the piece mold process and better adapted than the lost wax process to the duplication of castings.

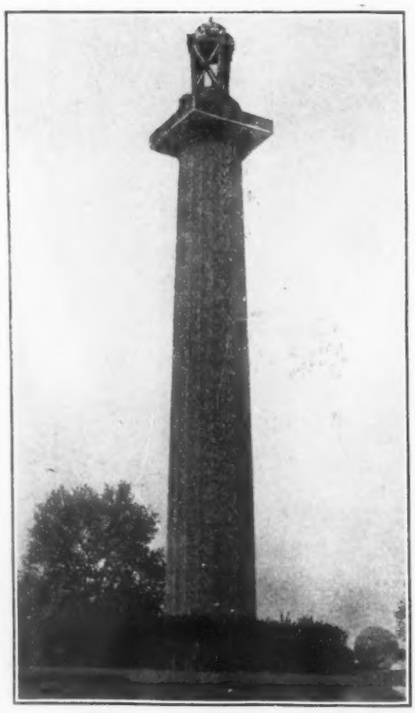


FIG. 7—THE PRISON SHIP MARTYRS' MONUMENT SURMOUNTED BY A MAGNIFICENT BRONZE URN

Plaster Patterns

The pattern is made of plaster of paris from a clay model by the usual piece mold process; then all undercut parts are fitted with prints, the sides of which are pared down to a proper angle to permit of the easy withdrawal of the pattern from the mold. The prints are then detached from the pattern, and the core boxes are made therefrom in plaster of paris, after which the prints are fastened back in place on the pattern. Fitting

the prints and making the core boxes requires considerable ingenuity in order to insure the face of the core being made entire and free from pasted joints or anything that would mar the smoothness of the contour. The molds are molded in the ordinary manner, fine sand being used to produce a smooth surface. The cores are dried before insertion and are faced with the same grade of molding sand that is used for the mold, bonded with molasses or glue water. The cores should be a snug fit, and care must be exercised to set them exactly even with the surface of the mold. If nailing is necessary to prevent floating, the nails are fitted into grooves in the cores, so they can be entirely covered with sand, leaving no indication of their presence in the casting. The line of junction between core and mold is obliterated by the crevices being filled and smoothed over. The entire mold is then sprayed with molasses water, dusted with plumbago or fine flour and afterwards skin dried. The dry sand core method is very convenient also for making small undercut castings such as are occasionally

FIG. 8—"THE COMING OF THE WHITE MAN", CONSIDERED THE MOST MAGNIFICENT OF THE INDIAN GROUPS

made for the ornamentation of chandeliers, etc. A case in point is that of a bronze elephant weighing two pounds. By a piece-mold process it

FIG. 9.—A VIEW OF THE BRONZE URN SURMOUNTING THE MONUMENT SHOWN IN FIG. 7

required five hours to make each mold, but after being fitted with block prints the work was given to an ordinary jobbing molder, who made the molds at the rate of 20 a day in a flask filled with miscellaneous jobbing patterns.

Wax Process and Piece Molds

The print method has, of course, its limitations and cannot be employed in the molding of the eagle or to statues generally. In making such castings there is a choice of two methods, the *cire perdue* or lost wax process and the piece mold. Most of the statues illustrated were made by the latter method, which consists in constructing the mold of as many pieces as are rendered necessary by the number of undercuts. In the case of a circular pattern, the first thing to determine is, the best plane on which to make the parting, after which the pattern is bedded in a match or oddside to the level convenient for parting the mold and usually it is laid on its side. A parting is then made, the drag put on, after which all undercut parts are rammed with French molding sand. This is rather a tedious operation as only a small amount of sand can be rammed at a time. The sand is packed in tightly with a small hammer and the edges of the sand are trimmed sharp and clean. The core is then lifted out, dusted with soapstone or lycopodium to make it part readily, and is then replaced. The next undercut section may be a continuation of the one already rammed so that the false core will, in this case, fit against the core already made. This core, when made, is also lifted out and fitted back, after being dusted with parting, and the operation is repeated until the figure is entirely covered with false cores, some being isolated and others touching, according to the number of undercut points on the figure. The upper surfaces of the false cores should be shaped so that a mold can be taken off without the sand sticking at any point. Parting is then dusted over the figure and cores and the drag is rammed, rolled-over and the flask part that served as a match is lifted away. When ramming what we have called the drag, precautions should be taken to secure the sand by bars, gaggers and soldiers, such as are used in ramming a cope, as both parts of the mold are subjected to rough usage.

Making the Cope

The cope is made next in the same manner as the drag and when it is lifted off all the little cores remain in place on the pattern. The cope is then rolled back and the cores are individually lifted away from the figure and are fitted in their proper

FIG. 10—BACK VIEW OF THE INDIAN GROUP SHOWN IN FIG. 8

place in the cope, no attempt being made to fasten them solidly in place. The match is then closed over the drag and the flask is rolled-over and the drag lifted off, the same process being repeated as with the cope.

When all the cores have been fitted in both halves of the mold, it is thoroughly baked and is then ready for the operation of making the core. The core is rammed inside the mold, and in some cases thickness strips of clay are placed over the mold to make the core smaller; again, the sand is rammed into the mold and after the core has been removed, it is shaved off for the thickness. In the latter case the mold, with all its false cores in place, is rammed up like a core box, an operation that requires care so as not to break the sand of the mold. The core is stiffened by wires and iron bars built into an open framework called an armature, and wax vents are bedded in all parts where gas is likely to collect and are carried to a large central duct. The mold may be clamped together and the core rammed from the bottom through an opening provided for this purpose. The construction of the core calls for much ingenuity, not only to avoid injury to the mold, but to properly vent and secure it, and when it is completed one-half of the mold is removed, leaving the false cores on the sand core in the same positions occupied on the plaster pattern. The cores are lifted off and are placed back in position in the half mold, only this time they can be permanently secured in place. The match is again closed onto the drag and the flask is rolled-over, the drag lifted off and the false cores are put back into their places in the drag, leaving the main core a complete figure, a sand duplicate of the plaster pattern.

Shaving the Core

The next operation is to shave the core. This is facilitated by dusting it with soapstone, which affords a means of distinguishing between the parts that have been shaved and those that have not. The shaving is done with a sharp knife and the sand is cut away equal to the thickness of the metal desired in the finished statue. In the process of shaving, many details are eliminated, but these are of no consequence in the inside of a statue, the main object being to keep the thickness fairly uniform to avoid shrinkage. The core is anchored in the mold by steel pins, which are run into the core at the parting line and at various other places where necessary. These pins are later pulled out of the casting and the holes are plugged by tapping them and screwing in pieces of bronze, which, when the casting is finished, cannot be detected. Copper or bronze chaplets are not considered as satisfactory as the pins, as they might melt and allow the core to shift.

After the mold has been blackened, it is thoroughly dried and is usually poured while hot, as the metal in the casting is usually quite thin and has a long way to run. An intricate system of gates is required, leading from the pouring gate to every part of the mold. When the casting is removed from the sand, the network of gates give it the appearance of being enveloped by a grape vine, and in fact this is the name by which the gates are known. When statues are cast in several pieces—as they cannot be either brazed or soldered and not show the divisions—they must be joined by skillful mortise and tenon work, the extensions and recesses of which are cast onto the adjoining parts of the various pieces and are afterward carefully fitted to each other and are then pinned together.

Suggestions for the Molder

It will be obvious to those skilled in molding that there are a number of factors that require attention and that are essential to the successful production of the casting. In the first place the flask must consist of three interchangeable parts. The various cores must be more than ordinarily strong to withstand the amount of handling to which they are necessarily subjected, especially when fitting the clay thickness. The cores must also carry marks of identification and should be provided with means of attachment to the mold backing. The cores must be strengthened and supported by wires to enable them to be withdrawn from the cavities of the pattern without breaking. The main core must be rodded, vented and so securely anchored in the mold that there is no possibility of its shifting when the metal strikes it. The core vents have to be protected against the metal, and the gates have to be provided for, while the mold is being constructed. Practice, of course, makes perfect and experience will suggest the invention of many conveniences and changes in methods until a system is finally developed that insures the maximum of certainty of results.

Lost Wax Process

The lost wax process, also known as the *cire perdue*, was the method practiced by the ancients and is extensively followed at the present time for making small castings. The name is derived from the fact that the pattern is made of wax and being melted out of the mold is, of course, lost. A detailed description of this process, as practiced by the Italians, was published in the February, 1911, issue of THE FOUNDRY, and it may be remarked that the same precautions in this method of molding are necessary in regard to the proper rodding, venting and securing of the core as are applicable in the case of the piece mold process. The importance of these features is usually ignored in descriptions of this method of molding, but the practical founder will realize the necessity of taking them into consideration. In the modern method of making large castings by the lost wax process, the idea that underlies the making of a wax model is to allow the sculptor an opportunity of retouching the figure before it is cast.

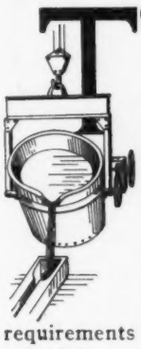
The mold is made practically the same as in the piece molding process, and it is assembled as if a bronze casting were to be made, only in place of the metal, wax is poured into the mold and when set, the outer mold is removed together with all the small cores; being of no further use, the mold is destroyed, a new mold being finally rammed over the wax pattern with its inner core of sand, after which the wax is melted out and the mold is baked at a sufficiently high temperature to remove every trace of the wax. The advantage of this process is that it permits all of the fins to be removed that would have been formed by the numerous small cores and also enables the artist to do a final retouching and shows up any dangerously thin spots that might not have run in bronze. A fine surface is also given to the casting, but the process is more expensive than piece molding, and all things considered, it is doubtful whether the advantages are sufficient to compensate for the extra expense.

Atomic Weights

The new table of atomic weights, recently published by the International committee, consisting of F. W. Clarke, W. Ostwald, G. Urbain and T. E. Thorpe, changes the atomic weights of calcium from 40.9 to 40.7; erbium from 167.4 to 167.7; iron from 55.85 to 55.84; mercury from 200 to 200.6; tantalum from 181 to 181.5 and vanadium, from 51.06 to 51. Niton, the gaseous emanation from radium, is also admitted as a new element, its atomic weight being placed at 222.4.

Modern Acid Open-Hearth Steel Casting Plant

A Description of the Features of Construction and Equipment of Plant No. 2 Built by the Union Steel Casting Co., Pittsburgh



TO MEET the constantly growing demand for steel castings, the producing capacity, in recent years, has been greatly increased. Many new plants have been built and extensions to existing shops, of no mean proportions, have been made. The expanding steel casting requirements of the railroads has resulted in a rapid growth of the basic and acid open-hearth melting capacity and the demand for small cast steel sections, notably for the automobile trade, has led to the recent installation of numerous converters. The tonnage for the railroads, of course, is greatly in excess of that of any other industry, and many of the large open-hearth steel casting plants specialize in that line of work.

The largest and most notable of the recent steel foundry extensions is plant No. 2 of the Union Steel Castings Co., Pittsburgh. This foundry adjoins this company's plant No. 1 and has increased the steel casting output of the works to 3,600 tons monthly. The layout and general arrangement of the departments of this new shop are unique and measure up to the most modern and best designs of foundry engineering. The equipment consists of devices which are known, from years of experience, to effect great economies in steel foundry practice.

Layout of the Plant

A plan of plants Nos. 1 and 2 is illustrated in Fig. 15. It will be noted that the property is bounded by Butler street and the Allegheny river and that the power house and pattern sheds are on the opposite side of the tracks of the Allegheny valley railroad, which run through the property. An overhead bridge has been built over these tracks to remove the danger of crossing and renders the power plant and pattern sheds easy of access. The layout of the entire works, to a large extent, was governed by the topography of the site, as the street is on a level considerably higher than the Allegheny Valley tracks. In the erection of both plants a large portion of a hill had to be excavated and as the floors of the foundries are considerably above the level of the tracks, concrete retaining walls almost entirely surround both shops. The buildings of plant No. 1, in length, parallel one of the side lines of the property, whereas plant No. 2 has been built parallel to the street and railroad tracks and the successive manufacturing operations carry the product across the works at right angles to the length of the buildings.

Railroad sidings for the receipt of raw material and the shipment of castings extend into both plants. The spur which serves the stock yard of plant No. 2 is depressed a sufficient depth to bring the floors of freight cars and the yard on the same level and concrete retaining walls have been built on either side of this track. The siding into the finishing shop has been depressed from 4 to 8 feet below the floor level, as illustrated in the view of the annealing furnaces, Fig. 3, and the foundry floor is supported by a concrete wall.

As shown in the cross-section of the new plant, Fig. 13, the foundry consists of three communicating main buildings, practically under one roof.

FIG. 1—TAPPING SIDE OF THE ACID OPEN-HEARTH FURNACES

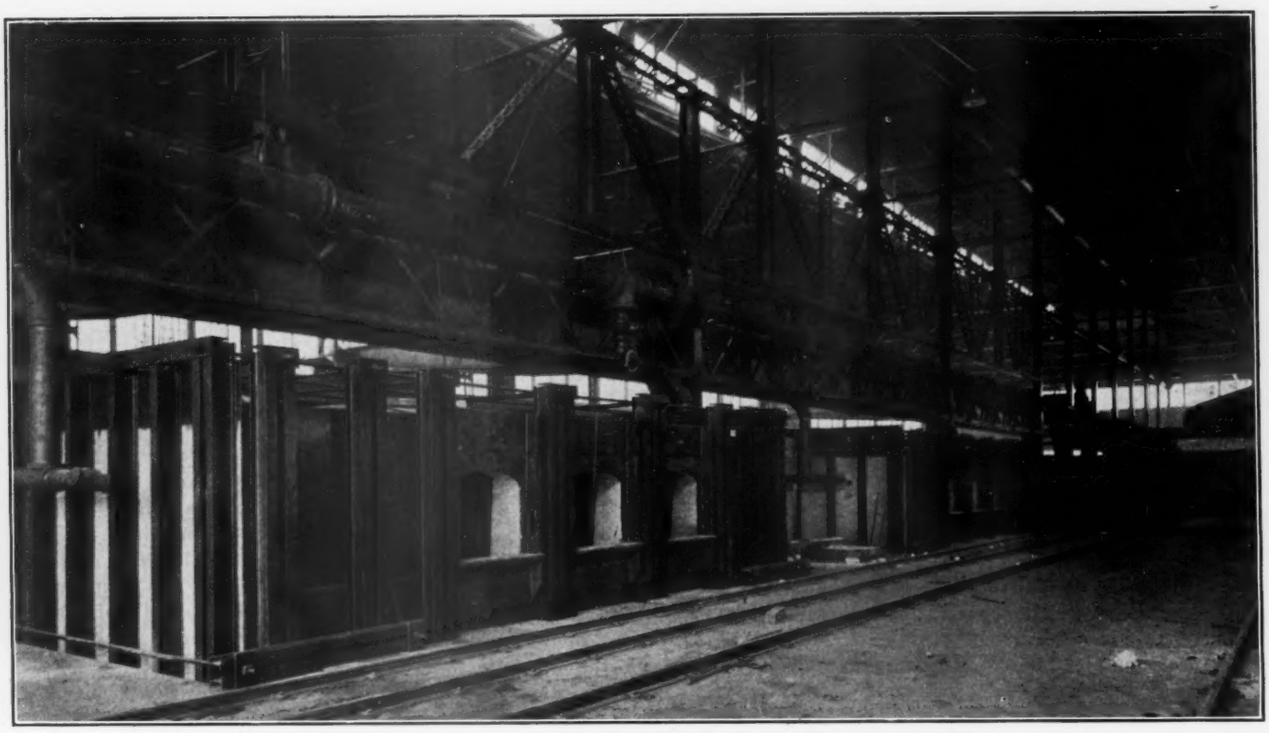


FIG. 2—THE OPEN-HEARTH FURNACE CHARGING FLOOR

As previously stated, the sequence of manufacturing operations is across the width of the plant and the various processes can be readily followed, in regular order, in this illustration. The molding department for bench and small floor work is near the street line, as shown in the plan, Fig. 15. The molding floor for large work adjoins the dog house and the core shop, core and mold drying ovens are in a lean-to between the large work molding floor and the casting shop. All of the ovens are used for drying both molds and cores and have doors at both ends to permit of delivering the dried molds to the casting floor from the molding departments. After shaking out, the castings are delivered to the finishing shop by a transfer crane, Fig. 7, to the cranes in this department, which convey the castings to the machines for the various finishing operations. As shown in Figs. 7 and 13, the finishing shop is on a level slightly below that of the other departments, and a concrete retaining wall supports the floor of the furnace room and the casting shop on the finishing department side. Fig. 4 is a view diagonally across the shop from the heavy molding floor, which shows the transfer crane, open-hearth furnaces and the finishing shop in the distance.

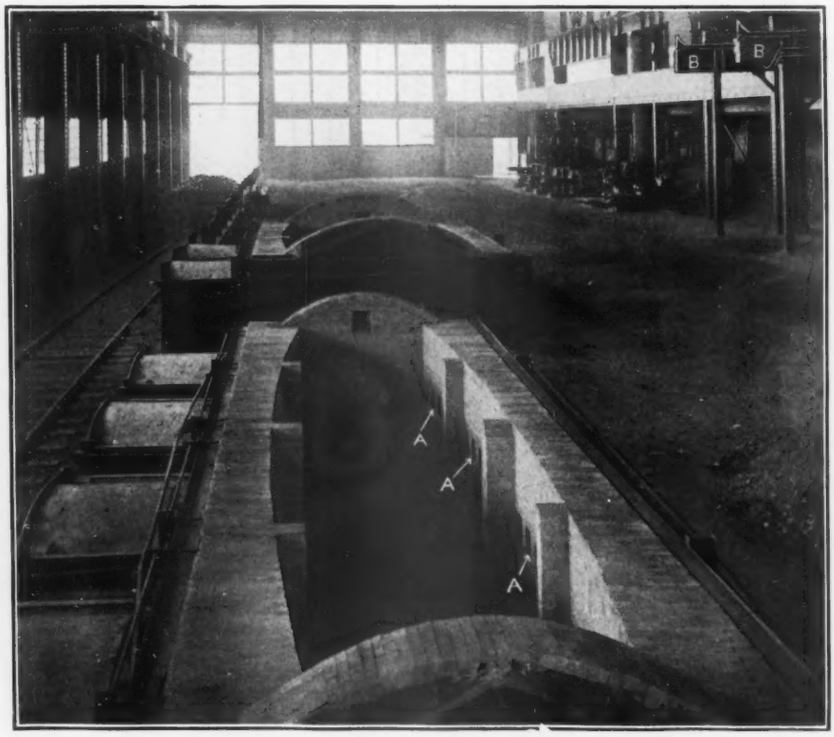


FIG. 3—FURNACES FOR ANNEALING STEEL CASTINGS; THE ONE IN THE FOREGROUND IS ESPECIALLY ADAPTED FOR LOCOMOTIVE FRAMES

Construction of Buildings

The buildings are of steel construction, the columns being supported on concrete piers. The side walls, to heights varying from 6 to 10 feet, are built of concrete, and between the windows and eaves the buildings are enclosed with corrugated iron sheathing. The molding floors and core shop are in one building, the small work molding floor being located in a lean-to, 200 feet x 34 feet 11 inches, the heavy work floor in the middle bay, 280 x 58 feet, and the core department is in the other lean-to, 240 feet x 39 feet 9 inches. In the adjoining building are located the casting shop and furnace department. The casting floor covers an area of 280 feet x 63 feet 6 inches, and the furnace room is 140 x 37 feet. As the open-hearth furnaces only occupy a

FIG. 4—A VIEW ACROSS THE PLANT, SHOWING THE CORE DEPARTMENT, FURNACES, TRANSFER CRANE AND THE FINISHING SHOP IN THE DISTANCE

space one-half the length of this building, a gallery floor has been built beyond the transfer crane runway in which the store room is located. The finishing shop is 71 x 300 feet and adjoins the furnace department and casting shop.

Ample light and ventilation are provided by rows of sliding windows in the sides and ends of the buildings and by the pivoted sash in the monitors which is operated in 40-foot sections by pendant chains. For artificial illumination, 50, 500-watt Mazda lamps have been installed at sufficient heights to clear the cranes.

Melting Equipment

The melting equipment consists of two 25-ton acid open-hearth furnaces, designed and built by Wm. Swindell & Bros., Pittsburgh. Ample space has been provided also for the installation of a third furnace. The furnaces are fired with natural gas, but are also equipped for the use of oil in the event of a failure of the natural gas supply. The oil is stored in two 10,000-gallon gravity discharge tanks and is distributed by two duplex Worthington pumps. The charging floor of the furnaces, Fig. 2, is 26 feet 5 inches wide and is covered with steel plates to a point a short distance from the fronts of the furnaces. The space between the furnaces and the steel floor is covered with castings, thereby obviating the warping of the charging floor directly in front of the furnaces. The charging machine track is 11-foot gage and the track for the charging buggies is 3-foot gage. The electrically-driven charging machine is of the high type, 10,000 pounds capacity, built by the Morgan Engineering Co., Alliance, O. The charging platform extends into the stock yard a distance of 20 feet and on this extension the charging boxes are loaded onto the charging buggies by the yard crane. The space underneath this platform in the yard is used for the storage of ore and furnace supplies. The tapping side of the open-hearth furnaces is illustrated

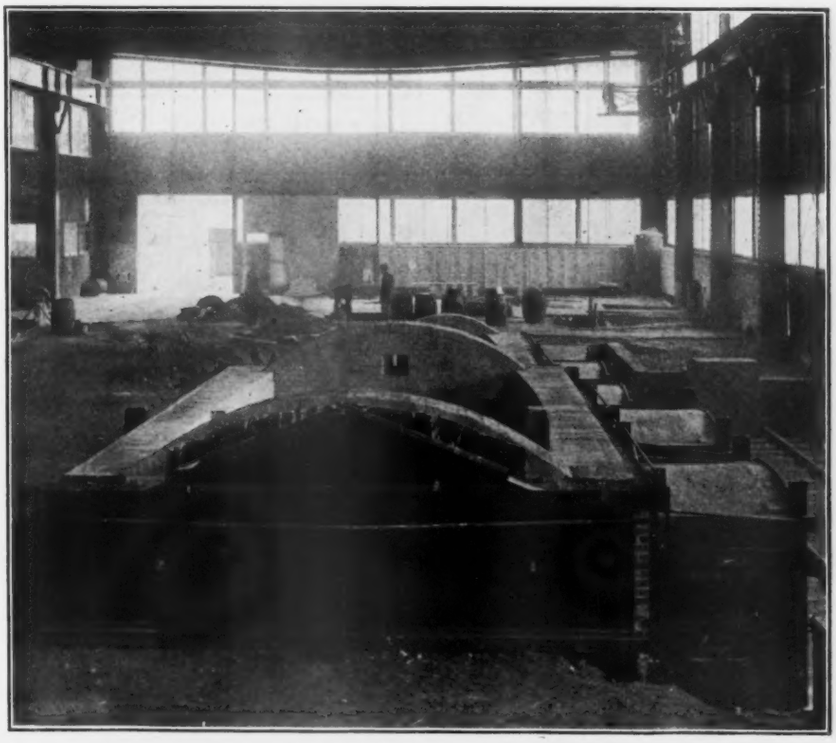


FIG. 5—THE LARGE FURNACE WHICH IS USED FOR ANNEALING DRIVING WHEEL CENTERS AND MISCELLANEOUS WORK

FIG. 6—A VIEW OF THE MOLDING SHOP, SHOWING THE SMALL WORK DEPARTMENT AT THE RIGHT AND CORE OVENS AT THE LEFT

in Fig. 1. The ladles, it will be noted, are set into pits, which extend slightly below the level of the casting shop floor.

The charging buggies are of exceedingly simple design, the platforms consisting of one piece steel castings. A rib extends the full length of the car platform, which engages with a slot cast into the bottom of the charging box and serves to center the box on the car platform.

Mold Drying Equipment

Views of the molding floors at opposite ends of the shop, with the drying ovens at the left and the light work floor at the right are shown in Figs. 6 and 8. When these photographs were made the drying ovens were in course of construction. The oven tracks extend into the molding shop a short distance to facilitate the placing of the molds onto the drying oven buggies. The core and mold drying equipment consisas of three double-track ovens, 19 x 42 feet; six single-track ovens, 9 x 42 feet; two ovens 6 x 8 feet and one, 10 x 31 feet. The ovens are all 9 feet high and the tracks are 60-inch gage. The ovens are designed to burn either natural gas or crude oil. The drying oven cars have one piece cast steel tops fitted with axles and wheels.

The opposite end of a battery of ovens, with the doors raised, is illustrated in Fig. 17. This is a view of one end of the casting shop and shows the discharge side of the ovens. After the molds have been dried they are removed from the ovens in the casting shop and placed on the floor

FIG. 8—ANOTHER VIEW OF THE MOLDING ROOM, SHOWING THE END OF THE SHOP OPPOSITE TO THAT ILLUSTRATED IN FIG. 6

FIG. 7—THE TRANSFER CRANE LEADING FROM THE CASTING TO THE FINISHING SHOP

where they are closed ready for casting. At the left in Fig. 17 is shown a brick-lined casting pit, 22 x 17 feet and 9 feet deep. The walls are arched for increased strength as the weight of the castings on the foundry floor has a tendency to crowd in the sides of the pit. The pit, it will be noted, is surrounded by a railing to guard against the danger of the employes falling into this opening in the foundry floor.

After the castings are shaken-out they are transferred to the finishing department by the transfer crane, Fig. 7. The crane runway is 20 feet wide and the crane has a capacity of 20 tons. Fig. 14 is a general view of the finishing shop, showing the machine tools at the left and the concrete retaining wall at the side of the shipping track at the right. All

of the finishing tools are arranged along one side of the shop with the annealing ovens at one end. As the Union Steel Casting Co. makes a specialty of locomotive frames, in addition to its other line of railroad and jobbing work, it became necessary to install tools of a sufficient size to finish these large cast steel sections as economically as possible and at one setting.

To finish these large steel castings in one operation and with one setting, the large shaper, shown in Fig. 12, was especially designed and built by the Morton Mfg. Co., Muskegon Heights, Mich. This tool has a bed, 40 feet long, and is equipped with two individual motor-driven traveling heads. This tool has sufficient capacity to remove the heads from the largest locomotive frame in one operation and without resetting. The shaper is equipped with four adjustable work tables. On small work the shaper can operate on two castings at one time. Each traveling head is operated by a 10-horsepower General Electric motor. The other finishing equipment consists of three Morton, motor-driven shapers, Fig. 16, one of which is equipped with a vise for holding small work; one motor-driven Betts boring mill of the tire-turning type; two motor-driven, Newton cold saws, Fig. 11, respectively, 48 and 30 inches; three swinging grinders driven by 7½-horsepower motors, installed by the Pittsburgh Emery Wheel Co., Pittsburgh; one Bridgeport, motor-driven stationary grinder and a motor-driven, 3 x 6-foot tumbling barrel. The finishing equipment of this shop is unique, inasmuch as all of the tools are driven by individual motors.

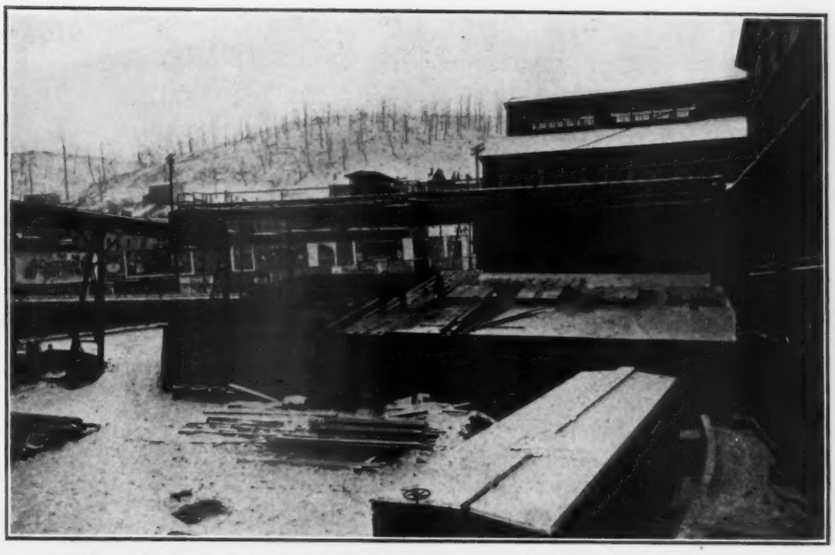


FIG. 10—A VIEW IN ONE PORTION OF THE STOCK YARD, SHOWING THE SAND STORAGE

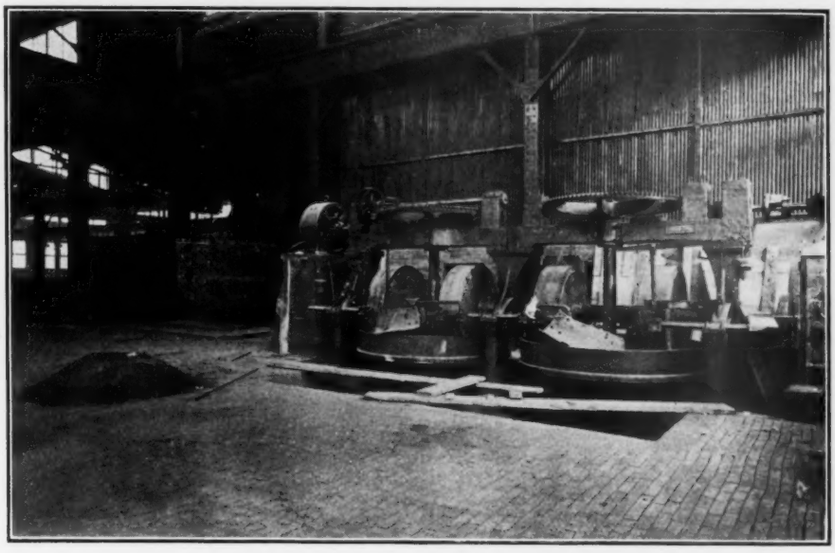


FIG. 9—THE SAND GRINDING PANS

The majority of the castings manufactured by this company are annealed and two large furnaces for this work have been installed in the finishing department. The furnace in the foreground, Fig. 3, has been especially designed for annealing locomotive frames, while the other oven in the background, shown more clearly in Fig. 5, is for miscellaneous work and driving wheel centers. While the annealing of steel castings is being given careful consideration by steel foundrymen, many of the ovens in use are merely brick chambers so designed that the uniform anneal of the sections charged therein cannot be affected. In both these views the covers of the furnaces have been removed to show more clearly the

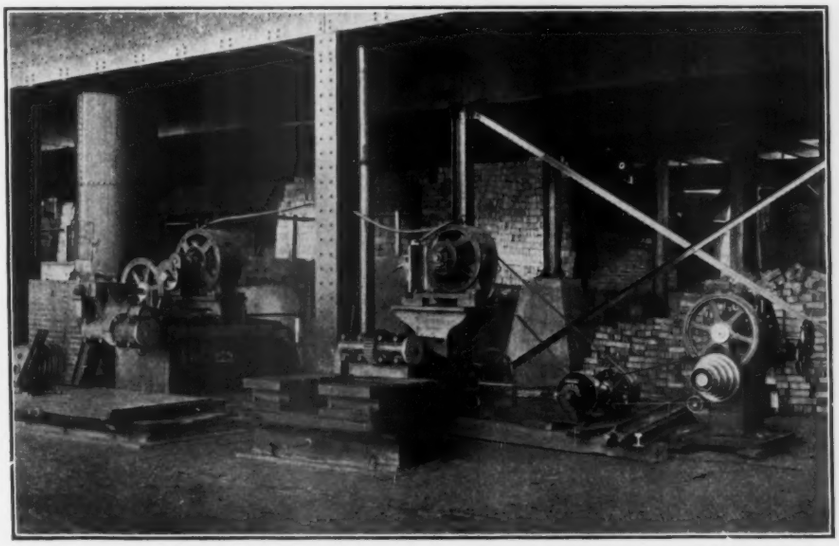


FIG. 11—A VIEW IN THE FINISHING SHOP, SHOWING THE MOTOR-DRIVEN CUTTING-OFF SAWS

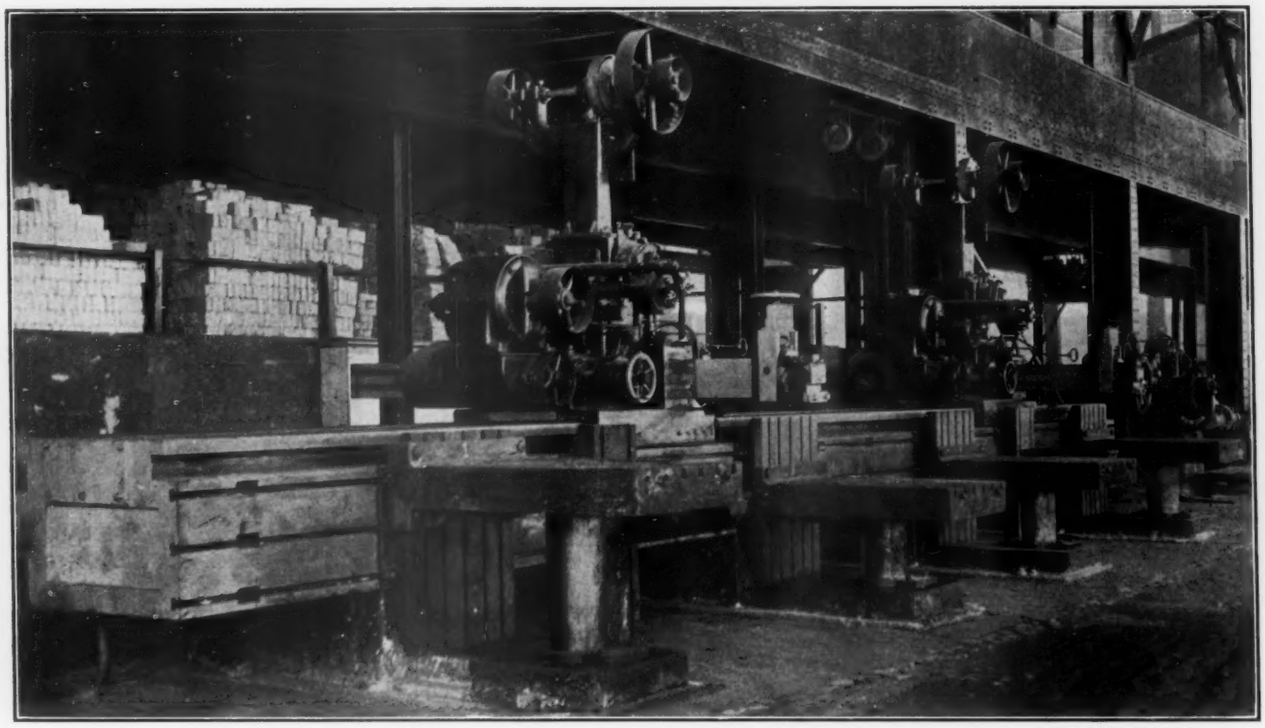


FIG. 12—THE LARGE 40-FOOT SHAPER WHICH IS EQUIPPED WITH TWO MOTOR-DRIVEN TRAVELING HEADS AND FOUR ADJUSTABLE WORK RESTS

interior construction. The covers are sectional, lined with fire brick and are removed by the traveling cranes.

The furnace for annealing locomotive frames, in the foreground, Fig. 3, is 40 feet long, 6 feet wide and 4 feet deep. The four fire boxes are shown at the left and the downtakes are illustrated at *A*. The furnace is so arranged that the heat enters from the fire boxes, passes over the castings and enters the downtakes, passing through flues underneath the furnace bottom, thereby heating this part of the oven, into the main flue to the 54-inch stack which carries off the waste gases from both furnaces. The furnace for annealing locomotive driving wheel centers and miscellaneous work, shown in Fig. 5, is 20 feet long, 10 feet wide and 7 feet deep.

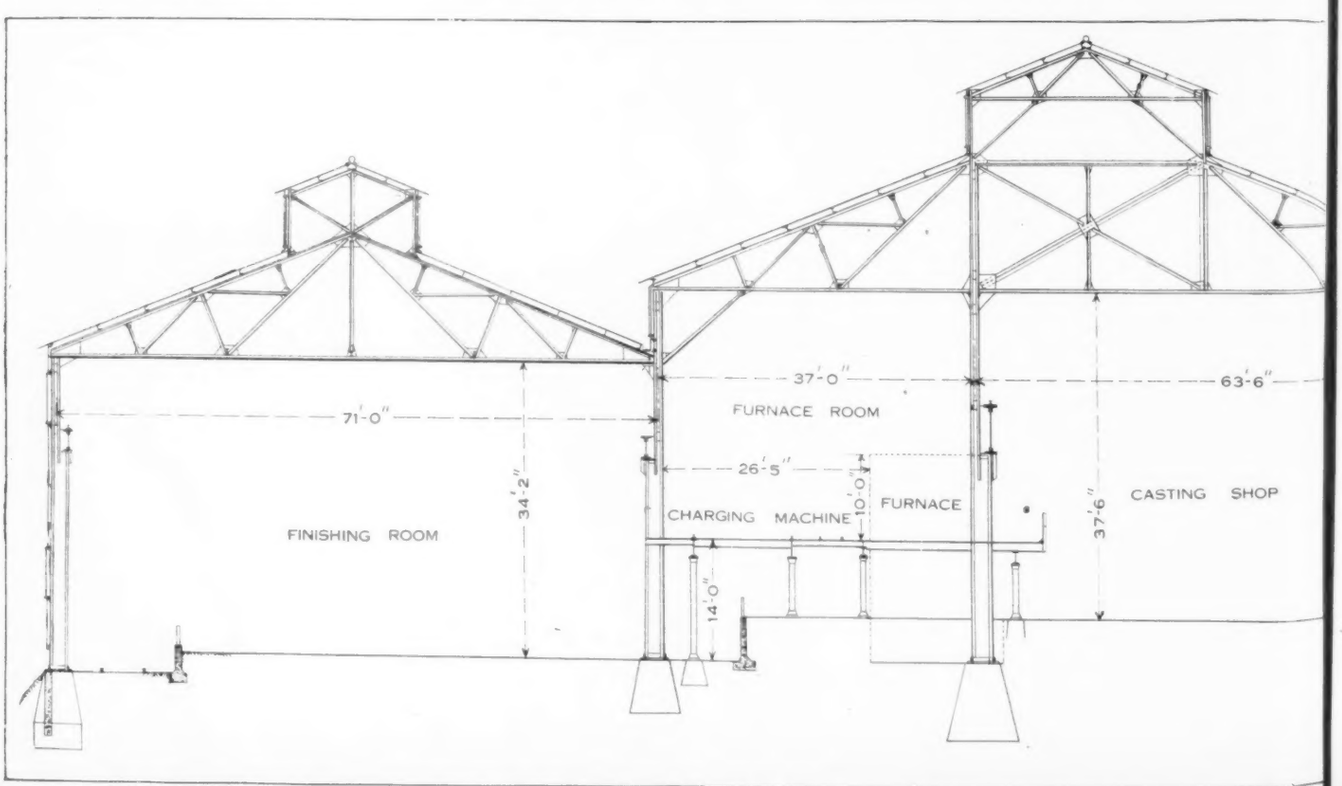


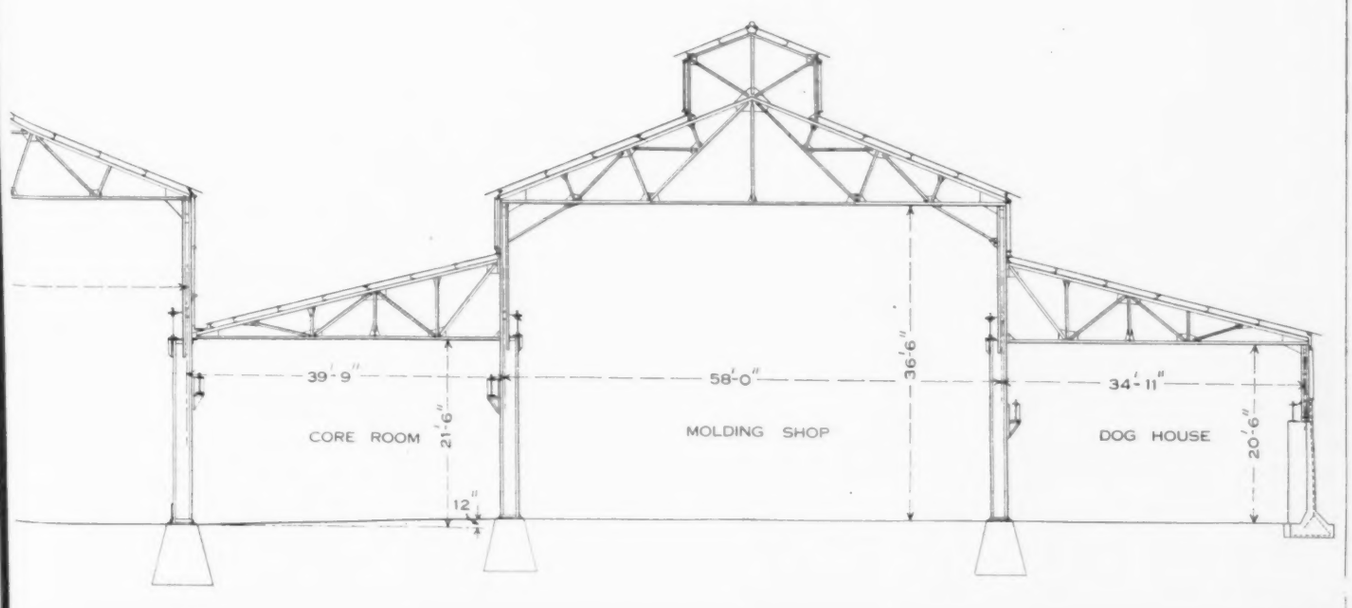
FIG. 13—A CROSS-SECTION OF THE NEW PLANT OF THE UNION STEEL CASTING CO., PITTSBURGH, SHOWING

FIG. 14—A GENERAL VIEW OF THE FINISHING SHOP, SHOWING THE MOTOR-DRIVEN TOOLS ARRANGED IN A ROW AT THE LEFT; THE DEPRESSED TRACK IS AT THE RIGHT

It is provided with two fire boxes, but otherwise is similar in construction to the furnace for locomotive frames. The heavy fire brick walls of both furnaces is a noteworthy feature and as they are built into the ground and only extend slightly above the foundry floor level, the charging and discharging is greatly facilitated.

To provide against the caving-in of the walls from the pressure of heavy castings on the finishing floor, the walls of the furnaces are arched and in addition, are braced by steel channels tied together with rods. The ends and sides are further reinforced with steel plates. The furnaces are fired with natural gas, but are equipped also to burn oil. In Fig. 3, *B* indicates the end of the transfer crane runway which connects the casting with the finishing department. After the castings have been annealed and finished they are loaded onto cars on the depressed shipping track, illustrated at the left, Fig. 3.

The sand-handling, storage and



THE MOLDING DEPARTMENTS, CORE ROOM, CASTING SHOP, FURNACE ROOM AND FINISHING SHOP

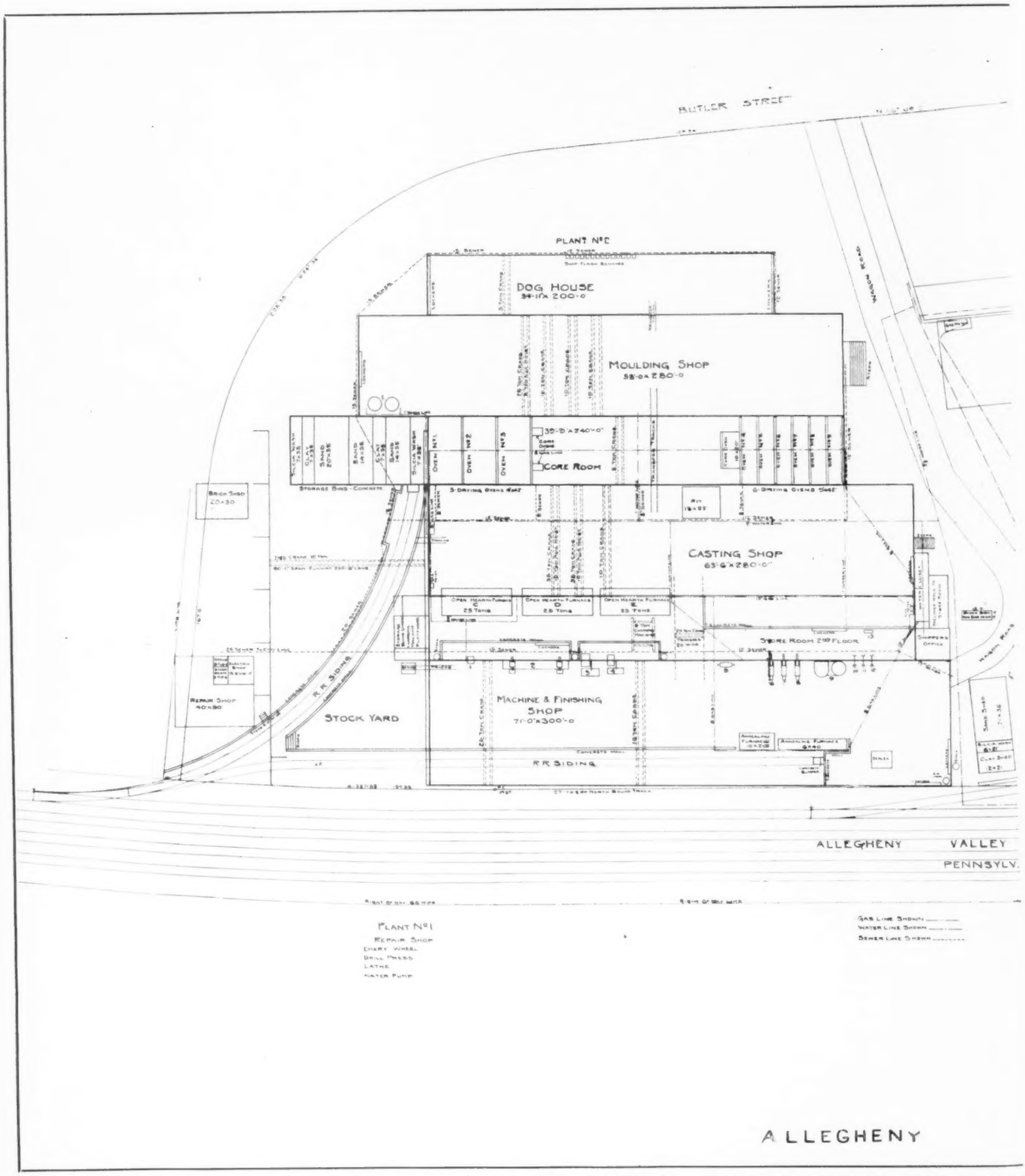


FIG. 15—GROUND PLAN OF THE WORKS OF THE UNION STEEL CASTING CO., PITTSBURGH; PLANT NO. 2 HAS ONLY RE PRACTICE IN STEEL

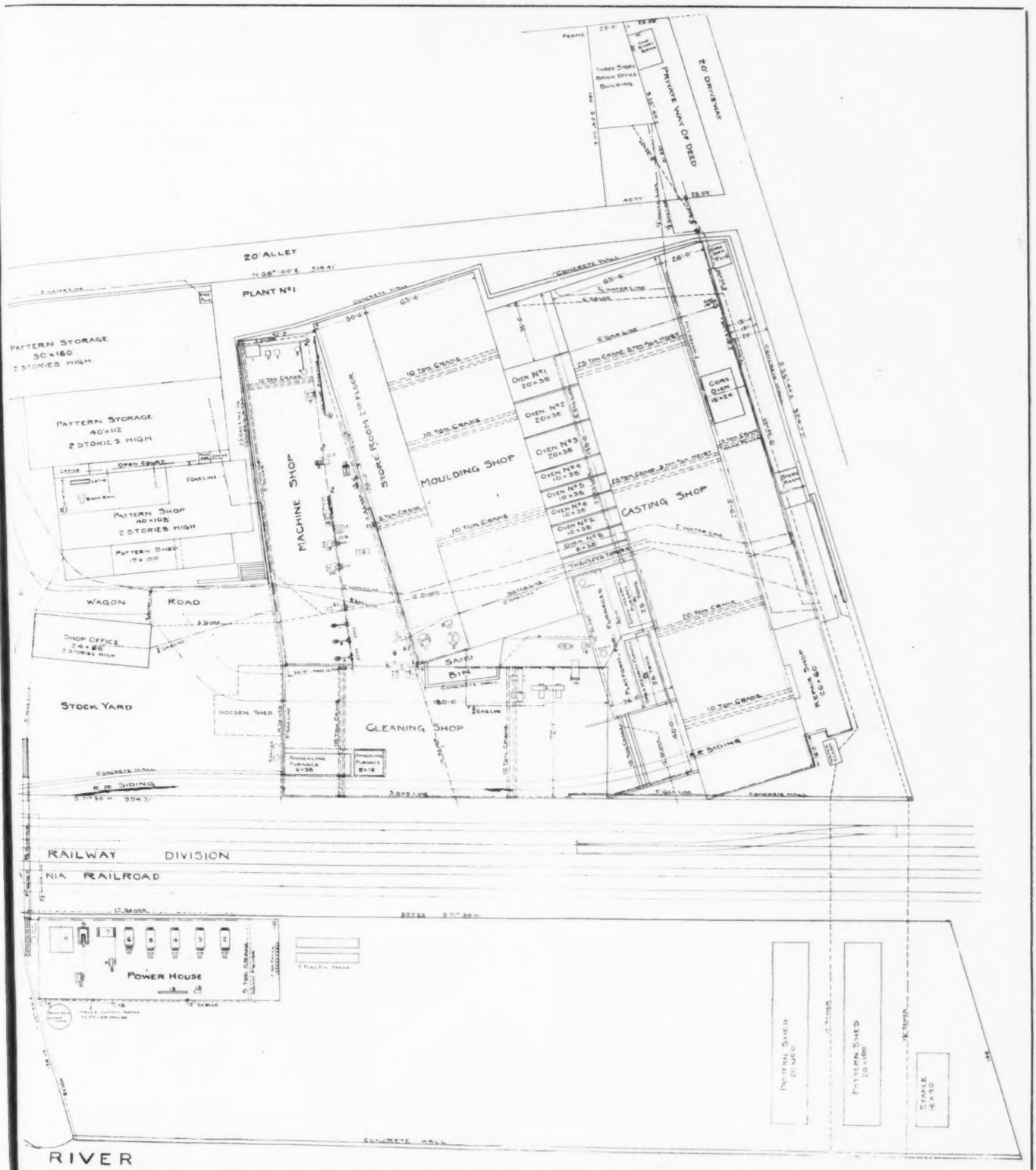
Key to Ground Plan

Plant No. 1.

No. 1.—Annealing furnace.
Nos. 2, 3, 4 and 5.—Blacksmith's forges.
No. 6.—Blower.
No. 7.—Hammer.
No. 8.—Air tank.
No. 9.—Tool grinder.
No. 10.—Air pump.
No. 11.—Drill press.
No. 12.—Transformers.
No. 13.—Resistance coil.
No. 14.—Switchboard.
No. 15.—Starting box.
No. 16.—Lathe.
No. 17.—40-horsepower motor.
No. 18.—Starting box.
No. 19, 20 and 21.—Shapers.
No. 22.—Air tanks.
No. 23.—Shears.

CLEANING SHOP.

Nos. 1, 2, 3, 4 and 5.—Emery wheels.
No. 6.—Starting box.
No. 7.—Water pump.
No. 8.—20-horsepower motor.
No. 9.—Starting box.
Nos. 10 and 11.—Cold saws.
Nos. 12 and 13.—7-horsepower motors.
Nos. 14 and 15.—Planers.
No. 16.—Cold saw.
No. 17.—Tumbling barrel.
No. 18.—30-horsepower motor.



CENTLY BEEN BUILT AND ITS LAYOUT AND GENERAL ARRANGEMENT IS CONCEDED TO REPRESENT THE MOST MODERN FOUNDRY ENGINEERING

MOLDING SHOP.

Nos. 1 and 2.—Sand mill.
No. 3.—20-horsepower motor.

POWER HOUSE.

No. 1.—Air pump.
Nos. 2, 3, 4 and 5.—200-horsepower gas engines and generator.
No. 6.—140-horsepower gas engine and generator.
No. 7.—125-horsepower gas engine.
No. 8.—75-horsepower generator.
No. 9.—Air compressor.
No. 10.—60-horsepower motor.
No. 11.—Motor-driven air compressor.
No. 12.—Switchboard.
No. 13.—Motor generator set.
Nos. 14 and 15.—Deep well pumps driven by 5-horsepower motors.

Plant No. 2.

CLEANING AND MACHINE SHOPS.

No. 1.—Blacksmith's forge.
No. 2.—Shaper with two traveling heads.
No. 3. — 20-horsepower, motor-driven cold saw, 48 inches.
No. 4. — 10-horsepower, motor-driven cold saw, 30 inches.
No. 5, 5-horsepower, motor-driven tumbling barrel.
Nos. 6, 7 and 8.—7½-horsepower, motor-driven shapers.
No. 9.—25-horsepower, motor-driven boring mill.
Nos. 10, 11 and 12.—7½-horsepower, motor-driven swinging grinders.
No. 13. — 10-horsepower, motor-driven stationary grinder.

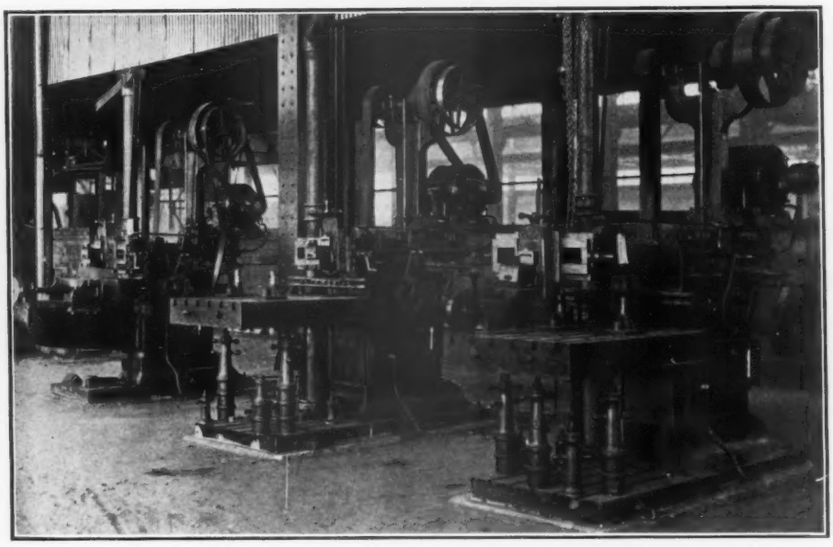


FIG. 16—ANOTHER VIEW IN THE FINISHING SHOP, SHOWING THE MOTOR-DRIVEN SHAPERS

grinding facilities have been designed with a view of effecting the greatest possible economies. The sand is received in the stock yard and is unloaded into buckets from the cars. The buckets are picked up by the yard crane which conveys them to the sand storage and dumps their contents into sand bins through openings in the roof of the sand storage. This building is of concrete construction, 38 x 80 feet, and adjoins the molding shop at the end of the casting building, as illustrated in Figs. 10 and 15. The sand storage has a capacity of 30 carloads, and is divided into seven bins, respectively, as follows: Silica wash, 7 x 38 feet; clay, 7 x 38 feet; sand, 20 x 38 feet and 14 x 38 feet; clay, 7 x 38 feet; sand, 14 x 38 feet, and silica wash, 7 x 38 feet. Openings in the roof of the sand storage over each bin are provided, as shown in Fig. 10. When sand is not being unloaded these openings are covered. An opening in the sand storage leads to the sand-preparing plant, Fig. 9, which consists of two motor-driven grinders. From this point the sand is delivered to the various floors in the molding shop.

The stock yard, only a portion of which is shown in Fig. 10, is 90 x 185 feet, and is served by a 10-ton electric traveling crane. All of the raw material for plant No. 2 is received over the depressed track which extends diagonally across the yard to the sand storage. The span of the crane runway is sufficient to command five cars on this track. Scrap, pig iron and other raw materials for the open-hearth furnaces, with the exception of ore and supplies, are stored in the yard, where the charging boxes are also filled and deposited on the charging floor extension by the yard crane.

The following crane equipment for the entire plant was furnished by the Morgan Engineering Co., Alliance, O.: Light molding department, one 5-ton; heavy molding shop, three 10-ton and one 25-ton with a 5-ton auxiliary hoist; core room, one 5-ton; casting shop, two 35-ton with 10-ton auxiliary hoist and one 10-ton; transfer crane, 20 tons, 20-foot span; finishing shop, one 25-ton and one 10-ton; yard crane, 10 tons, and power house crane, 5 tons. In addition to the cranes, transfer tracks are provided for carrying flasks from the casting to the molding departments.

A brick pavement has been laid in the molding shop and core department to prevent the accumulation of sand, which in time has a tendency to raise the level of the floors. In the finishing shop, for a distance of 60 feet at the shipping end, an asphalt block pavement has been laid. A new fireproof pattern storage building, 50 x 160 feet, two stories high, is now being erected.

The power plant is located on a strip of land between the Allegheny Valley tracks and the Allegheny river. The building is of brick and steel construction,. 44 x 135 feet, and is served by a 5-ton crane. The equipment consists of four 200-horsepower Westinghouse gas engine generating sets; one 140-horsepower Westinghouse gas engine generating set; one 125-horsepower gas engine belted to generator; one 400-cubic foot Franklin air compressor belted to motor; one 1,000-cubic-foot Laidlaw-Dunn-Gordon air compressor direct-driven by a 185-horsepower motor and two 3-cylinder, 50-horsepower, vertical Westinghouse gas engines, belt-connected to generators which furnish power for electric welding devices. Provisions have been made for the installation of an additional alternating current generating set. All of the crane motors as well as those driving the tools in the finishing shop, with the exception of the Morton shapers, are of the Westinghouse type. The controllers are of the Cutler-Hammer drum type.

A repair shop, 40 x 50 feet, is now in course of construction, which will be equipped with the necessary tools for plant repairs. The equipment will consist of one 30-inch, 18-foot bed, motor-driven New Haven lathe and the following machines, which will be belt-driven: One 30-inch Gray planer with a 6-foot bed; one 4-foot radial drill; one power-driven hack saw and a stand of emery wheels.

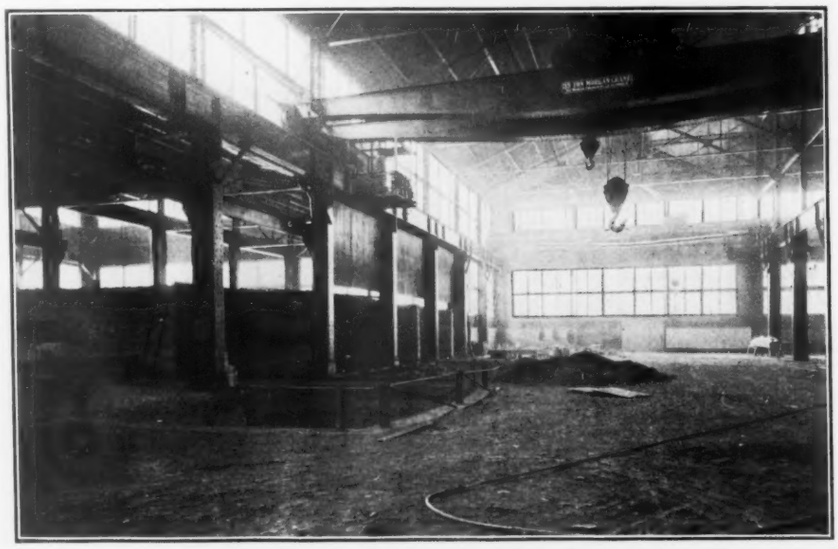


FIG. 17—A VIEW IN ONE END OF THE CASTING SHOP, SHOWING THE BRICK-LINED CASTING PIT AND A BATTERY OF CORE OVENS AT THE LEFT

The Sly Sand Blast

A new type of sand blast, manufactured by the W. W. Sly Mfg. Co., Cleveland, is shown in the accompanying illustration. The machine is 36 inches in diameter, 36 inches deep and requires only three horsepower to operate. The capacity of the machine varies according to the nature of the work to be cleaned. A charge of light, thin castings will vary from 300 to 500 pounds, while on heavy work the mill can handle from 500 to 1,200 pounds per charge. The time of sand-blasting varies from 6 to 15 minutes and each sand blast nozzle requires approximately 200 cubic feet of air per minute at a pressure of 40 pounds. Each mill is provided with two sand blast nozzles. The sand can be used until it is reduced to dust and by a special method of elevating the sand to the hopper, the sand is automatically returned to the mill without handling. At the same time the fine dust is separated from the sand and is not returned to the sand hopper. This dust can be used as a parting material. All operating parts are dust-proof and the entire equipment is enclosed to prevent the leakage of dust into the cleaning room. The sand blast mill, dust arrester, fan, pulleys, piping, etc., constitute one unit. The low speed of the mill eliminates breakage and preserves the most delicate outlines of ornamental work.

Tropenas Converter Plants

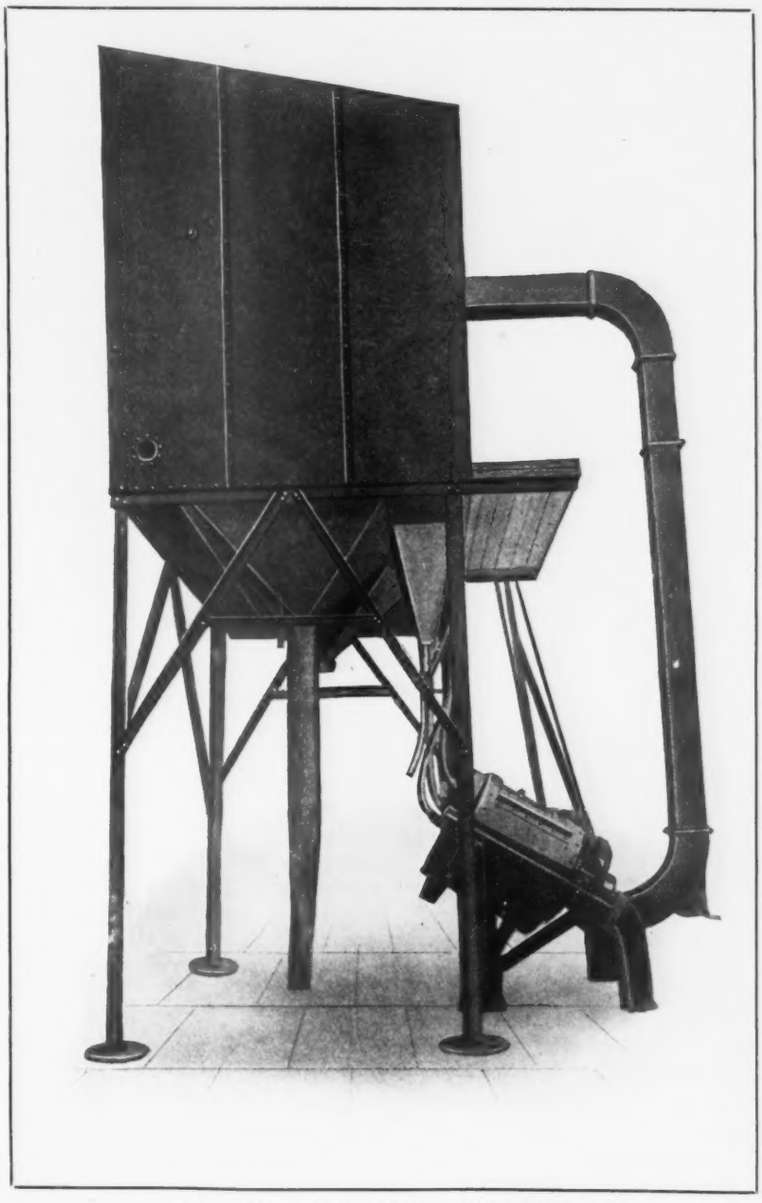
The number of converter plants for the manufacture of steel castings is rapidly increasing. The Tropenas Converter Co., 50 Church street, New York City, reports renewed activity in the demand for its equipment and is now furnishing the Isthmian canal commission a complete steel foundry outfit for installation at Gorgona, Canal Zone. It will consist of a Tropenas, new style, 2-ton converter, high pressure blower for the converter, sand mixer, ladle heaters, ladles and all of the necessary supplies for this equipment. Another contract was placed recently with the Tropenas Converter Co. by the Industrial Works, Bay City, Mich., for one new style, 2-ton converter, the necessary high pressure blower, one No. 2 Tropenas cupola, ladle equipment, heaters and sand mixer. The Union Iron Works, Spokane, Wash., also has closed for Tropenas converter equipment, including one new style, baby converter, high pressure blower, sand mixer, ladles, ladle heaters, etc.

The Chicago Steel Foundry Co., which is erecting a new plant at Chicago, also has placed a contract for a Tropenas baby converter and No. 1 Tropenas cupola, blowers, ladles, ladle heaters, etc. One of the largest contracts placed recently was for the entire steel foundry equipment for the Davison-Namack Foundry Co., Ballston Spa., N. Y.

This equipment will include two standard 2-ton converters, blowers and sand mixer. The Tropenas Converter Co. reports that the outlook for the installation of converter equipment in South America, Japan, China and Europe is very good. In the United States the number of converter installations has increased rapidly and many gray iron shops are adding converter steel departments.

Wadsworth Core Equipment Line Extended

The Wadsworth Core Machine & Equipment Co., Akron, O., after thoroughly investigating the merits of the core machine built by the Detroit Core Machine Co., Detroit, has taken over the manufacture and sale of this device. It will be known as the Wadsworth-Detroit core machine and will further increase the extensive line of core room equipment manufactured by the Wadsworth Core Machine & Equipment Co. The Wadsworth-Detroit core machine is of the jar-ramming type and is adapted for ramming cores of irregular shapes. The Wadsworth company also manufactures core ovens, sand mixers, core cutting-off and coning machines, etc.



THE SLY SAND BLAST TUMBLING MILL

THE FOUNDRY

Published monthly by

The Penton Publishing Co.

Penton Building
CLEVELAND

BIRMINGHAM, ENG.....Prince's Chambers.
CHICAGO.....1328 Monadnock Block.
CINCINNATI.....808 Provident Bank Bldg.
NEW YORK.....1115 West Street Bldg.
PITTSBURG.....2148-49 Oliver Bldg.

Copyright, 1911, by Penton Publishing Co., in the United States and Great Britain.

The subscription price of THE FOUNDRY is $1.00 a year in the United States and Mexico. To Canada, $1.50. To Great Britain, Eight Shillings. Single copies, 15 cents each. Back numbers, three months or more, 25 cents each.

Change of advertising copy must reach this office on the 10th of the month preceding date of publication.

The Cleveland News Company will supply the trade with THE FOUNDRY through the regular channels of the American News Co.

European Agents: The International News Company, Breams Building, Chancery Lane, London, E. C., England.

PAID CIRCULATION OF THE FOUNDRY

January, 1909	9,143
January, 1910	10,373
January, 1911	11,060
June, 1911	11,110
January, 1912	11,026

Entered as second-class matter at the Post-Office at Cleveland, O.

Contents

Continuous Operations in a Radiator Foundry	1
The Production of Zinc	5
The Scientific Operation of a Foundry	6
Influence of Heat on Castings	8
A Modern Brass Foundry and Its Equipment	9
Fire Brick Tapping Hole	17
Mixtures for Plumbers' Goods	18
Babbitt Mixtures	18
Alloy for Bushings	18
Mixture for Blast Furnace Tuyeres.	18
Formula for Steam Metal	18
White Metal	18
Casting Works of Art in Bronze	19
Atomic Weights	24
Modern Acid Open-Hearth Steel Casting Plant	25
The Sly Sand Blast	35
Wadsworth Core Equipment Line Extended	35
The Foundry Trade in Retrospect	36
Personal	36
Obituary	36
Trade Notes	37
Institute of Metals	37
New Core Binders	37
Core Wire Straightening Machine	37
Aluminum Solders	37
A Combination Molding Machine	38
A Power-Ramming Molding Machine	39
A Combination Sand Mixer	39
General Industrial Notes	40

The Foundry Trade in Retrospect

Unfavorable trade conditions characterized the foundry industry during the last twelve months. The tonnage in all lines was considerably below normal and prices in many instances barely covered the cost of production. A declining market prevailed during the early months of the year and consumers deferred buying in the belief that lower values would obtain. The railroad interests vigorously enforced a policy of retrenchment and purchases were restricted to cover only immediate needs. As the railroad requirements represent a large percentage of the country's total iron and steel consumption, the small tonnage from this source materially affected production. For a period of practically nine months prices continued to decline and pig iron and finished steel products were quoted at considerably below the cost of manufacture. These low values proved attractive to a large number of consumers whose stocks were depleted and a buying movement was started which soon was followed by slight increases in prices. The leading trunk lines placed large orders for cars, locomotives and rails and trade conditions generally were favorably affected by the activity in the iron and steel industry. The outlook for the new year is exceedingly bright, and while an abnormal demand is not anticipated, yet it is believed that a sufficient tonnage will be placed to fully engage the entire producing capacity throughout the year. Pig iron fluctuations in 1911 reflected industrial conditions generally, and a comparison of prices prevailing a year ago and today is interesting, as it indicates a general decline in values in all centers. The following quotations are for No. 2 foundry:

	Jan. 1, 1911.	Jan. 1, 1912.
Pittsburgh	$14.65	$13.90
Chicago	16.00	14.00
Cleveland	14.25	13.25
Philadelphia	15.00	14.50
New York	14.75	14.50
Buffalo	14.50	13.00
Birmingham, Ala.	11.50	10.00
Cincinnati	15.20	13.20

Notwithstanding the unfavorable trade conditions, foundrymen generally improved their equipment with a view to reducing operating costs. Molding machine manufacturers, without exception, were busily engaged and in other equipment lines the buying reflected the improvements that were made to casting plants. One of the notable developments of the year was the introduction of the briquetting process to American foundrymen. This is in line with the conservation policy which is being considered seriously in all branches of manufacture. The process of briquetting borings of all kinds for remelting purposes will effect great economies and will permit of the consumption of scrap material which heretofore was disposed of with difficulty.

Personal

Chas. E. Simmons has been appointed general manager of the Ocala Iron Works, Ocala, Fla. About five years ago Mr. Simmons accepted a position as pattern shop foreman with this company and has been advanced successively to the positions of foundry foreman and shop superintendent. The Ocala Iron Works make a specialty of phosphate machinery and mill supplies.

Alfred Crook has been appointed general manager of the Philadelphia Roll & Machine Co., Philadelphia, to succeed the late August Marx. Mr. Crook served a molder's apprenticeship and for a number of years was employed as a journeyman in various shops at Youngstown, O., and at one time was a member of the firm of Crook & Griffith, foundrymen, but disposed of his interest to accept a position as superintendent of the foundry of the Youngstown Sheet & Tube Co. Five years ago he became connected with the Philadelphia Roll & Machine Co.

Obituary

John Gow, assistant foreman of the foundry department of the General Electric Co., Schenectady, N. Y., died Nov. 24 of pleuro-pneumonia, at the Physicians' hospital, Schenectady, N. Y. Mr. Gow was a native of Aberdeenshire, Scotland, and was born Nov. 23, 1875. He came to this country in 1893 and located in Geneva, N. Y., where he served a molder's apprenticeship in the shop of the New York Central Iron Works. About 12 years ago he obtained a position as a journeyman with the General Electric Co. and was later appointed assistant foreman of this company's foundry department. To his untiring efforts, hand molding in this company's casting plants has been almost entirely displaced by molding machine operations and being of an inventive turn of mind, Mr. Gow developed many labor-saving devices of value to the foundry industry.

William Weber, a well-known brass foundryman of Milwaukee, was struck and instantly killed by an automobile on Sixteenth street viaduct, Dec. 14,

1911. Mr. Weber was crossing the bridge and was unable to see the approach of the machine, because a locomotive passing underneath had enveloped the viaduct in a cloud of smoke. He is survived by a wife and four children.

Trade Notes

The Hill & Griffith Co., Cincinnati, manufacturer of foundry facings, supplies and equipment, is remembering the trade with a handsome calendar on which is embossed the head of a horse, entitled "The Prize Winner".

The December number of *American Vanadium Facts*, published by the American Vanadium Co., Pittsburgh, contains an exceedingly interesting article, entitled "Vanadium Steel in Machinery Equipment". Other subjects discussed include the use of vanadium in locomotive frames, the construction of rock drills, etc.

The Sullivan Machinery Co., Chicago, announces the removal of its office at Salt Lake City, Utah, from the Dooly building, where it has been located the past five years, to more commodious quarters in the Kearns building. M. G. Doll is local manager.

Walter B. Snow, publicity engineer, 170 Summer street, Boston, has recently added to his staff S. G. Koon, formerly editor of *International Marine Engineering*, and later connected with the Jones & Laughlin Steel Co. in the capacity of metallurgist, and J. S. Nicholl, formerly with the New York Edison Co.

T. P. Kelly & Co., New York City, manufacturers of foundry facings and supplies, have received orders from the following concerns covering their entire requirements for heavy, light and other facings for 1912: Detroit Stove Works, Peninsular Stove Co. and the Michigan Stove Works, Detroit, and the Cribben & Sexton Stove Co., Chicago.

The Adams-Bagnall Electric Co., Cleveland, announces the following changes: J. G. Pomeroy, formerly western sales manager, has been appointed sales manager, with headquarters at Cleveland, and C. L. Eshelman has just been appointed publicity manager, also with headquarters at Cleveland. The Adams-Bagnall Electric Co. also has opened an office at Boston under the management of E. R. Bryant, formerly connected with the New York office of this concern.

The Basic Mineral Co., Northside, Pittsburgh, manufactures a fluxing material known by the trade name of "Radioclarite", which is intended for use in melting brass, copper, lead, zinc, aluminum and other alloys. "Keystone Thermoflux", made by this company, is intended for use in melting gray iron. It has a tendency to clean the iron, reduces the shrinkage, slightly increases the strength and permits the use of an increased percentage of scrap.

In a 12-page pamphlet, published by McLain's System, Goldsmith building, Milwaukee, David McLain, the head of this foundryman's school, recounts his experiences and expresses freely his views regarding the lack of fundamental knowledge in the past, and still existent to some extent among foundrymen generally. The article is entitled "The Practical Education and Training of Foundrymen", and Mr. McLain's experience shows what may be attained by pluck and perseverance, even under circumstances which, in the initial stages, were more or less unfavorable to ultimate success.

The Lumen Bearing Co., Buffalo, has recently made the following changes in its organization: H. P. Parrock, formerly western representative, has been appointed sales manager, succeeding Allen Kendall, resigned; H. F. Russell, formerly purchasing agent, has been appointed sales representative in central and western New York and eastern Pennsylvania; Albert Lockwood succeeds Mr. Russell as purchasing agent; Louis S. Jones has been appointed sales representative in New England; H. O. Schwaner will represent the Lumen Bearing Co. in the Pittsburgh district, and Fred Ganderton, formerly associated with the Aluminum Castings Co., Cleveland, has been appointed sales manager of the Toronto, Ont., plant.

Institute of Metals

The annual meeting of the Institute of Metals will be held at the Institution of Mechanical Engineers, London, Eng., on Tuesday and Wednesday, Jan. 16 and 17. The meeting will open on Tuesday afternoon with the inaugural address of the president on the subject of "Copper and Its Alloys in Early Times". The papers that will be read at other sessions follow: "Properties of Certain Copper Alloys at High Temperatures", by G. D. Bengough; "Further Experiments on the Inversion at 470 Degrees in Copper-Zinc Alloys", by Prof. H. C. H. Carpenter; "Influence of Oxygen on Copper Containing Arsenic or Antimony", by R. H. Greaves; "The Nomenclature of Alloys", by Dr. W. Rosenhain; "Poisoned Brass and Its Behavior When Heated in Vacuo", by Prof. T. Turner, and a paper by Dr. Carl Benedicks, of the University of Stockholm, dealing with some novel experiments on a zinc-antimony alloy.

In connection with the annual meeting a dinner will be held on the evening of Tuesday, Jan. 16, at the Criterion restaurant.

New Core Binders

The Federal Foundry Supply Co., Cleveland, is now mnufacturing two new core binders, one liquid and one dry. The liquid binder, known as Corline, is a wood extract soluble in water and is suitable for both large and small cores and is recommended as a substitute for molasses. The dry core binder is recommended as a substitute for flour for making cores, paste and dough rolls. It is lighter in weight than flour and is from 30 to 50 per cent lighter than pitch core compounds. This binder generates only a small amount of smoke or gas and the cores made therewith are exceedingly fragile and can be easily clened out of the castings. This binder is particularly recommended for use in car wheel foundries where operations are continuous.

Core Wire Straightening Machine

The Hemming Bros. Co., New Haven, Conn., is manufacturing a core wire straightening machine, which has a capacity for straightening core wire as short as two inches and will also straighten a right angle bend. The No. 1 machine has a capacity for straightening wire from ⅛ to ⅜ inch in diameter and the No. 2 machine from ⅜ to ¾ inch in diameter. Another machine manufactured by this company is adapted for automatically straightening and cutting core wire direct from the coil. It will handle wire from 1-16 to 3-16 inch in diameter. This machine will cut wire accurately to length and there is no wire loss when starting the machine.

Aluminum Solders

Three aluminum solders, recently patented, have the following composition: Tin, 80 parts; aluminum, 17 parts; nickel, 0.7 parts, and magnesium, 2.3 parts.

Tin, 49.05 per cent; antimony, 3.43 per cent; lead, 26.06 per cent; zinc, 20.31 per cent, and copper, 1.10 per cent.

Tin, 76.1 per cent; zinc, 21.8 per cent, and copper, 2.1 per cent.

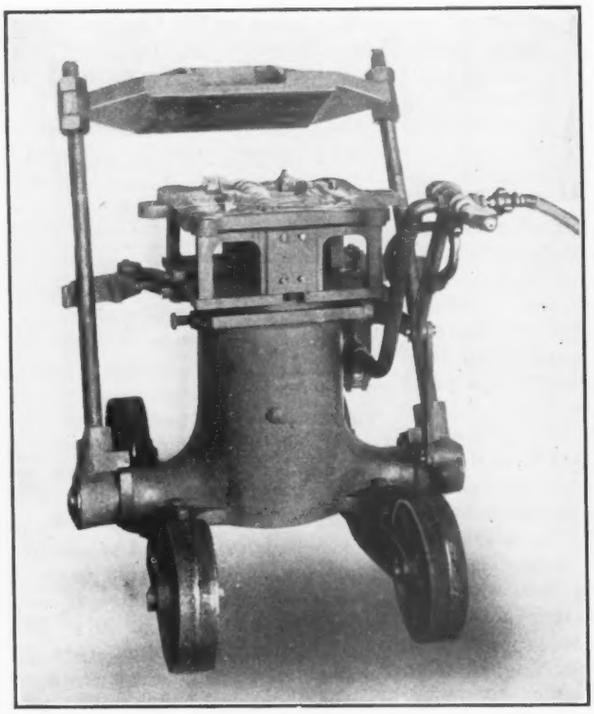


FIG. 1—COMBINED JARRING, SQUEEZING AND STRIPPING MACHINE

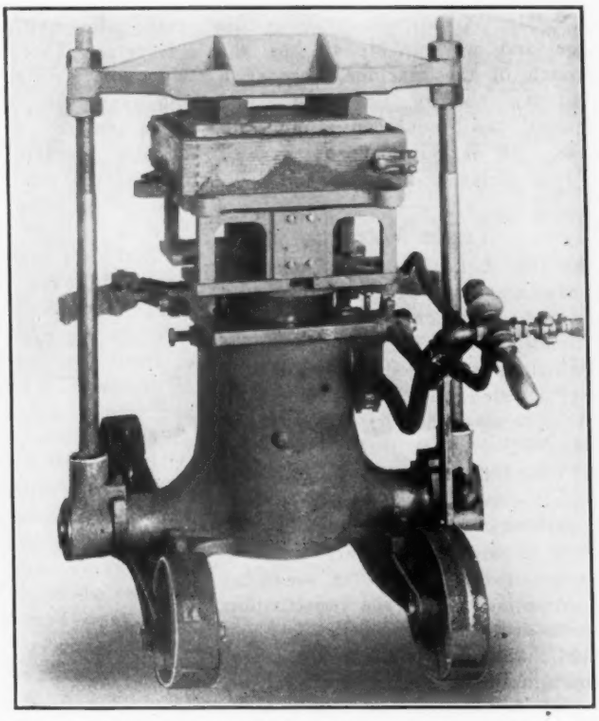


FIG. 2—MOLDING MACHINE IN SQUEEZING POSITION

A Combination Molding Machine

A combined jarring, squeezing and stripping molding machine, which can be used also as a jar-ramming molding machine, squeezer, combination jarring and squeezing machine, or as a split pattern molding machine, is illustrated in Figs. 1, 2, 3 and 4. This molding device is adapted for light and medium heavy work. The jarring feature of ramming the molds obviates the necessity of tucking bars and the sand, furthermore, is packed uniformly around the pattern. This machine, therefore, is adapted particularly for making molds for such light castings as stove plate, radiators, etc.

To reduce the cost of making special pattern equipment, the machine is so designed that pattern and stripping plate outfits used on hand-ramming stripping plate machines can be mounted on this machine without change.

In Fig. 1 a pattern plate is shown mounted on the table and the machine is arranged for the combined jarring, squeezing and stripping operations. The presser head is shown

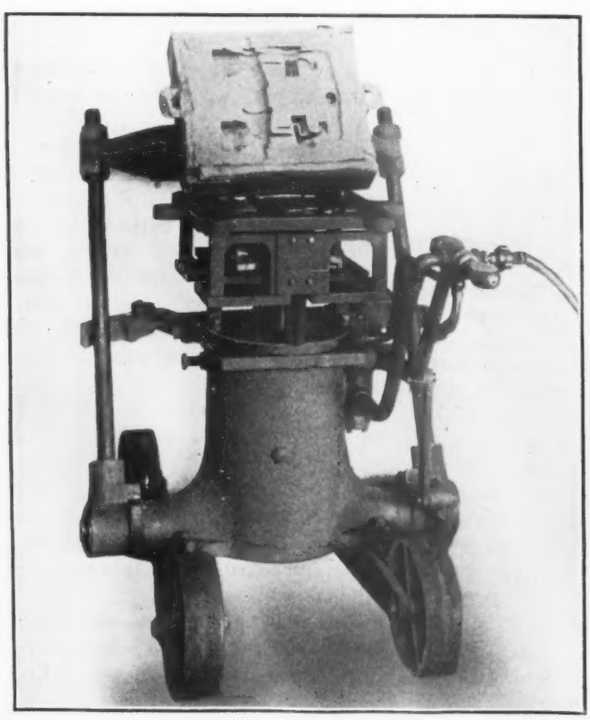


FIG. 3—MOLDING MACHINE IN STRIPPING POSITION

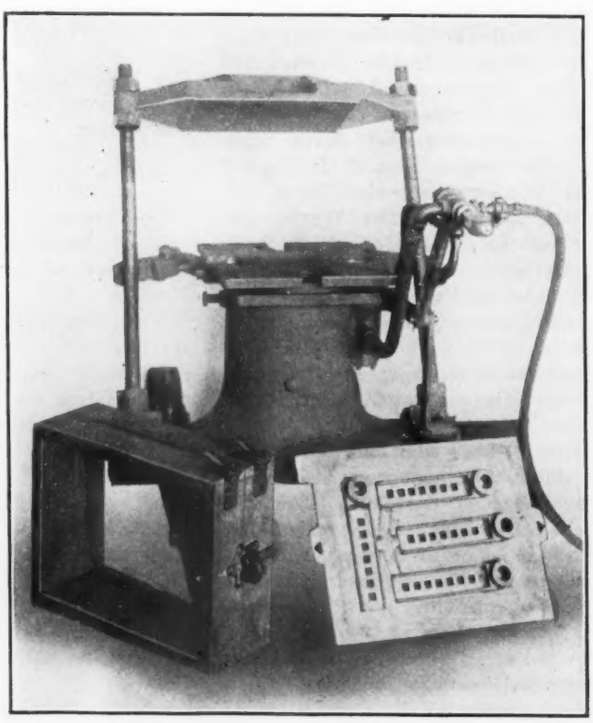


FIG. 4—MOLDING MACHINE ARRANGED FOR JAR-RAMMING AND SQUEEZING

FIG. 1—POWER-RAMMING MOLDING MACHINE WITH HEAD SWUNG BACK

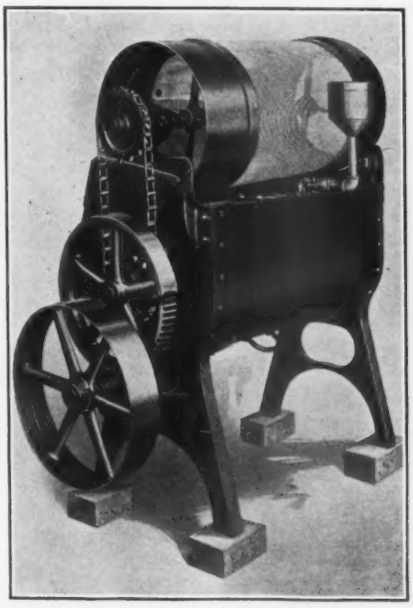
FIG. 2—POWER-RAMMING MOLDING MACHINE WITH HEAD IN RAMMING POSITION

swung back and after the flask has been filled with sand air is admitted to the jarring cylinder and a few rapid blows are sufficient to ram the sand around the pattern. The presser head is moved forward by bearing down on the valve handle and the mold is then in position for the squeezing operation. In Fig. 2 the machine is shown in squeezing position. This operation is performed by admitting air to the cylinder which raises the piston carrying the table, flask, etc. After releasing the air from the cylinder, the presser head is swung back by raising the valve handle. The shock of the backward movement of the head is absorbed by a spring gear. The stripping plate and the mold are lifted from the pattern by a small air cylinder inside of the squeezing cylinder and the piston. In Fig. 3 the latter operation is shown with the mold setting on top of the pattern plate. Fig. 4 shows the machine arranged for jar-ramming and squeezing. All of the molding operations are mechanically performed. The machine is portable, being mounted on four roller-bearing wheels. This permits of its easy movement along the gradually diminishing sand heap. This machine is built in two sizes by the E. Killing's Molding Machine Works, Davenport, Ia.

A Power-Ramming Molding Machine

In the accompanying illustration is shown a portable, power-ramming molding machine, built by the J. F. Webb Mfg. & Supply Co., Davenport, Ia. It is of the positive pressure type, 16 x 48 inches, the cylinder being 16 inches in diameter and the distance between the side rods is 48 inches. This is the largest power-ramming machine built by the Webb company and one of this size has been installed in the foundry of the Bonnet-Nance Stove Co., Chicago Heights, Ill.

The ramming cylinder is attached to the cross arm on the side rods and the entire ramming mechanism is counterbalanced with springs to facilitate the easy forward and backward movement of the ramming head. In Fig. 1 the ramming head is swung back in the position it assumes while adjusting the flask and filling it with sand, and in Fig. 2 the head is swung forward over the table in ramming position. The ramming pressure is controlled by the valve shown on top of the cross arm. This device permits of ramming all molds, from a certain pattern, of a uniform density. A knee vibrator is attached to the table of the machine and is used when the patterns are on cards or loose. The machine is portable, being mounted on four wheels.



A COMBINED SAND MIXER AND RIDDLE

A Combination Sand Mixer

The combined riddle and sand mixer manufactured by the Standard Sand & Machine Co., Cleveland, shown in the accompanying illustration, effects a considerable saving of labor, owing to the fact that only one shoveling operation is required to charge the machine for both screening and mixing. The sand is only handled once, being shoveled into the revolving screen, through which it is riddled into the trough of the mixer. The batch is immediately discharged into a wheelbarrow or similar vehicle, underneath the mixer. The mesh of the screen is of the proper size to effectively riddle the sand, and lumps and foreign particles are automatically discharged. At the right of the machine, on top of the trough, a tank is shown which contains the liquid required for binding or tempering the sand.

The pipe from this tank is connected with a spray pipe which extends the full length of the mixer trough, insuring a uniform distribution of the binding or tempering fluid. The sand is cut over 120 times a minute. The flow of the liquid is controlled by a valve. By this arrangement any desired ratio of binder to sand can be obtained. This machine is occasional-

ly furnished with two tanks, the one for water and the other for the binding compounds. The uniform distribution of the binder effected by this machine makes it possible to greatly reduce the amount usually required when the sand is mixed by hand. The mixing and tempering is accomplished by paddles in the mixer trough which cut-over, rub and mix the materials four times for every revolution of the mixer shaft which operates at the rate of 30 revolutions per minute. To prevent the packing of the mixture at the sides of the mixer shell, adjustable steel scrapers are provided. These likewise reduce the wear on the paddles and aid in mixing and discharging the contents. This machine, which is adapted for general foundry use, is built in four sizes, the smallest being shown herewith.

General Industrial Notes

The Iowa Valve Co., Oskaloosa, Ia., has taken over the Iowa Mfg. Co., of that city.

The American Machine & Mfg. Co., formerly located at Charlotte, N. C., has removed its plant to Greenville, S. C.

The M. H. Foundry Co., Belleville, Ill., has increased its capital from $10,000 to $50,000 and has purchased the buildings formerly occupied by the Belleville Tack Co., in which a brass foundry will be operated.

The De Bats Crucible Steel Co., Zelienople, Pa., has been incorporated with a capital of $125,000 to engage in the manufacture of steel castings. The incorporators are Louis De Bats and A. G. Zehner.

The Aurora Steel Tank Co., Aurora, Ill., has been incorporated with a capital of $20,000 and will operate a foundry, machine shop and boiler shop. The incorporators are Richard Harell, Chas. C. Chabut and O. P. Abell.

The Rochester Steel Castings Co., Rochester, N. Y., has been incorporated with a capital of $50,000 and will engage in the manufacture of steel castings. The foundry will be placed in operation about Sept. 1.

The Lebanon Steel Foundry Co., Lebanon, Pa., recently incorporated, is completing the erection of a foundry, 80 x 110 feet, for the manufacture of crucible steel and alloy castings. W. H. Worrilow is president and T. S. Quinn is secretary and treasurer.

The Upland Foundry & Machine Co., Upland, Cal., has been incorporated with a capital of $25,000 and has taken over the Koenig foundry. Emil Koenig is general manager of the new concern and H. O. Blohm, formerly connected with the Fulton Iron Works, San Francisco, has been appointed superintendent.

The M. Rumely Co., La Porte, Ind., manufacturer of agricultural implements, has increased its capital stock to $22,000,000 and has taken over the plants of the Gaar Scott Co., Richmond, Ind., and the Advance Threshing Co., Battle Creek, Mich. The M. Rumely Co. will continue the operation of these three plants.

The Murphy Foundry Co., Beaver Falls, Pa., has erected a large foundry of steel construction, 100 x 150 feet. The company will manufacture machinery castings, also carrying on a general jobbing business. The equipment includes a 10-ton cupola and a 10-ton crane. Lawrence Murphy is president, while W. G. Murphy, formerly foreman of the foundry of the Best Mfg. Co., Pittsburgh, and later connected with the United States Sanitary Mfg. Co., Monroe, Pa., is secretary and treasurer.

The Reading Steel Casting Co., with works at Reading, Pa., and the Bayonne Steel Casting Co., operating a steel foundry at Bayonne, N. J., have been consolidated under the firm name of the Reading-Bayonne Steel Casting Co. The capital of the new corporation is $750,000 and this will be increased from time to time to provide for the growth of the business. The combined capacity of the two plants is from 800 to 1,000 tons of steel castings per month. Both companies have well-equipped plants for the manufacture of medium and light weight Tropenas steel castings. The Reading Steel Casting Co.'s plant has been in operation for 5½ years and the Bayonne Steel Casting Co. is entering upon its second year. The officers of the Reading-Bayonne Steel Casting Co. follow: Wm. D. Sargent, chairman of the board of directors; J. Turner Moore, president; A. E. Williamson, vice president, and D. W. Yeckley, secretary and treasurer.

New Construction.

The Deming Co., Salem, O., is erecting an addition to its foundry, 50 x 50 feet.

The Pittsburgh Valve & Fittings Co., Barberton, O., is erecting an addition to its foundry, 60 x 560 feet.

The A. S. O'Neil Co., Los Angeles, is erecting an addition to its foundry on San Fernando street.

The Pittsburgh Valve & Fittings Co., Barberton, O., will erect a one-story addition to its foundry, 60 x 560 feet.

The Union Spring & Mfg. Co., Pittsburgh, is erecting an addition to its foundry, 40 x 60 feet, which will be equipped with a 10-ton crane.

The Pratt & Letchworth Co., Buffalo, is erecting a new steel foundry at its plant at Tonawanda street and the New York Central railroad.

The Hart & Crouse Mfg. Co., Utica, N. Y., manufacturer of furnaces and heating boilers, has commenced the erection of a foundry, machine shop and warehouse.

The Toppenish Iron Works, Toppenish, Wash., will erect an addition to its plant which will be used as an iron and brass foundry.

The New York Radiator Co., Utica, N. Y., is contemplating the erection of a foundry, 80 x 118 feet; machine shop, 75 x 80 feet, two stories, and a warehouse, 65 x 218 feet.

Vanderwest & Pease, Montgomery building, Muskegon, Mich., contemplate the erection of a two-story foundry, 100 x 196 feet, at an estimated cost of $30,000.

The Termaat & Monahan Co., Oshkosh, Wis., is erecting a new foundry adjoining its present plant. The new building will consist of two wings in the shape of an ell, each wing being 50 x 125 feet.

Among the new shops which the General Electric Co. is erecting at Erie, Pa., is a malleable foundry, 400 x 600 feet. The building will be of concrete, brick and steel construction.

The Busch-Sulzer Bros. Diesel Engine Co., St. Louis, organized early this year with a capital of $2,100,000, will erect a plant, including a foundry and machine shop, for the manufacture of engine castings.

The Quincy Casting Co., Quincy, Ill., has been incorporated with a capital of $10,000 and will immediately erect a foundry. The incorporators are Charles Schnellbacher, Lester Willis and George Beals.

The Milwaukee School and College of Aviation, Milwaukee, is erecting a foundry, 50 x 100 feet, for the manufacture of castings required in the construction of flying machines.

The Glenmoor Mfg. Co., East Liverpool, O., has been incorporated with a capital of $25,000 and will erect a plant, including a foundry and machine shop, for the manufacture of a patented metallic packing for engines.

Th North Buffalo Hardware Foundry, Buffalo, recently incorporated, with temporary offices at 28 Erie street, will erect a foundry, 65 x 250 feet, at Hertel avenue and the Erie railroad.

The Brisco Iron Works, Porterville, Cal., has been incorporated with a capital of $300,000 and will erect a plant, comprising a machine shop and foundry. The incorporators are T. A. Brisco, G. V. Reed and H. E. Redmond.

The Standard Foundry & Mfg. Co., Alma, Mich., recently incorporated, is erecting a foundry, 44 x 60 feet, and a machine shop, 40 x 200 feet. The equipment will include an electric crane and a steam or gasoline engine.

The Illinois Malleable Iron Co., Chicago, has completed the erection of an addition to its malleable foundry, 67 x 128 feet, and has also completed an annealing room, 118 x 145 feet. Six additional annealing furnaces will be built. L. W. Lukens is superintendent of the foundry.

The P. J. Smith Machine Co., Monroe, Mich., manufacturer of glue presses and special veneering machinery, will remove its plant to Bay City, Mich., where it will merge with the MacKinnon Boiler & Machinery Co. Several new buildings will be erected, including a foundry, 50 x 200 feet.

The Millers Falls Co., Millers Falls, Mass., has recently completed an extension to its foundry which will contain new pickling, tumbling, annealing, pattern and casting inspection departments. Additions are also being made to the woodworking shop. The capacity of the power plant was also recently increased.

Among the Brass Founders.

The Fairbanks-Morse Mfg. Co., Beloit, Wis., will shortly erect a brass foundry, 50 x 150

The Indiana Brass Co., Frankfort, Ind., has been incorporated with a capital of $10,000 to engage in the manufacture of brass and iron goods. The incorporators are J. A. Johnson, A. J. Johnson and C. Williams.